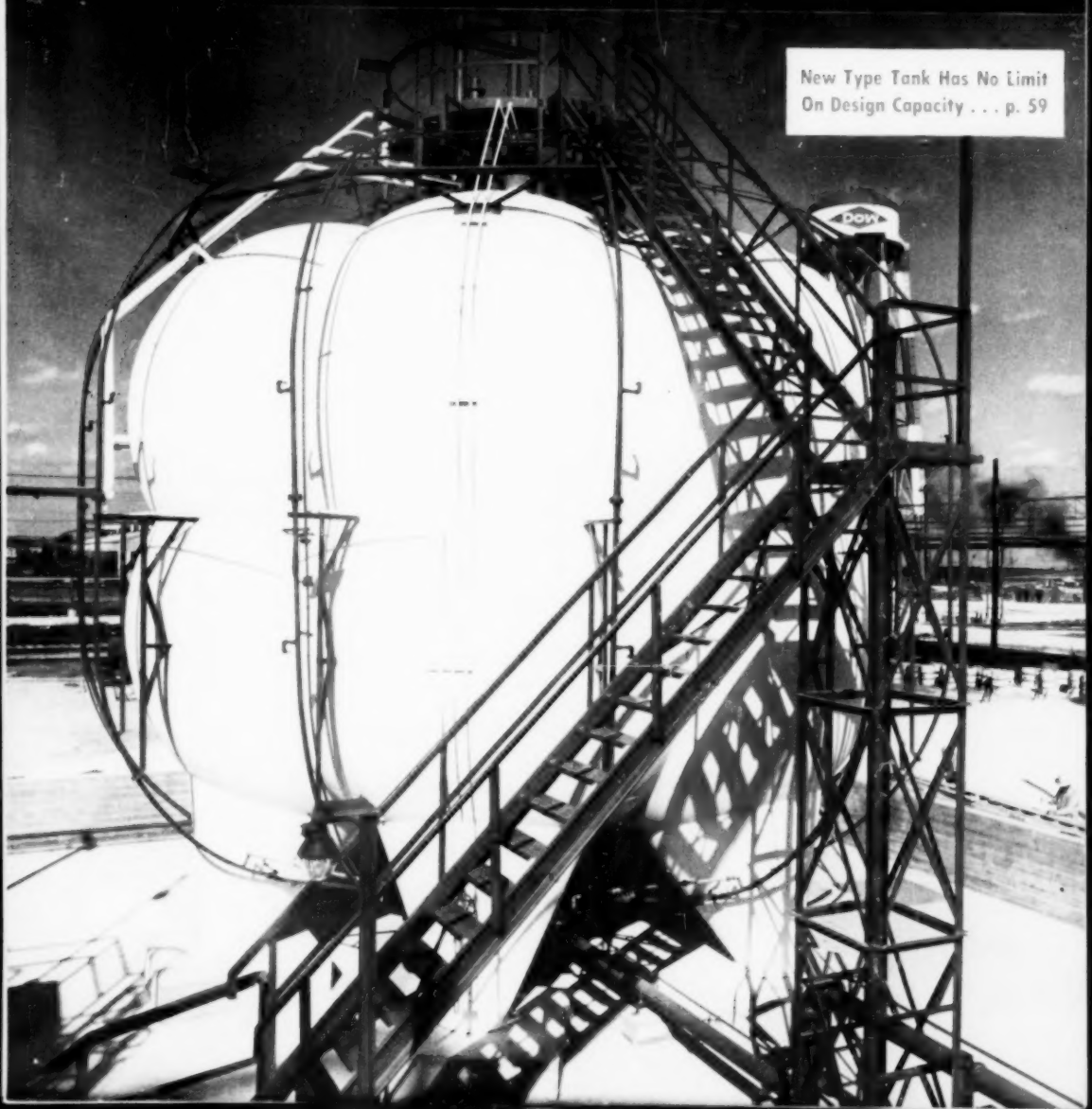
JANUARY, 1952
VOL. 7, NO. 1

PETROLEUM PROCESSING



New Type Tank Has No Limit On Design Capacity . . . p. 59

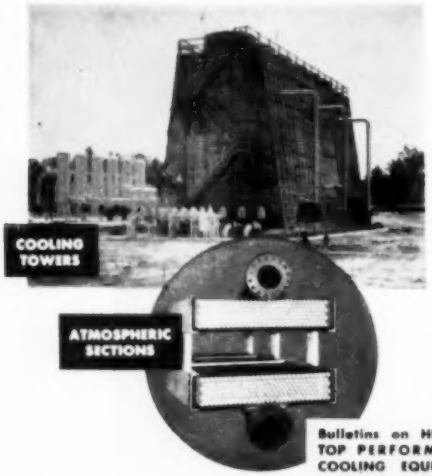
HUDSON SOLO-AIRE EXCHANGERS

Pictured above is an installation of HUDSON SOLO-AIRE JACKET WATER COOLERS providing cool water to the power cylinders, compressor cylinders, and lubricating oil coolers of ten 300 horsepower gas engine driven compressors. The coolers, using air as the cooling medium, and operating with inlet air temperatures ranging seasonally from below zero to 105° F, deliver cool jacket water at a *uniform, controlled* temperature the year around.

For this installation the great expense of obtaining and treating raw water determined the selection of HUDSON SOLO-AIRE units—rather than HUDSON water cooling tower with HUDSON water-cooled units. The use of air-cooled units in this compressor station precluded the loss through evaporation of about 90 gallons per minute of raw water.

HUDSON SOLO-AIRE units are in use in a great variety of process cooling and condensing services in chemical plants, refineries, and gas processing plants.

OTHER HUDSON "TP" COOLING EQUIPMENT



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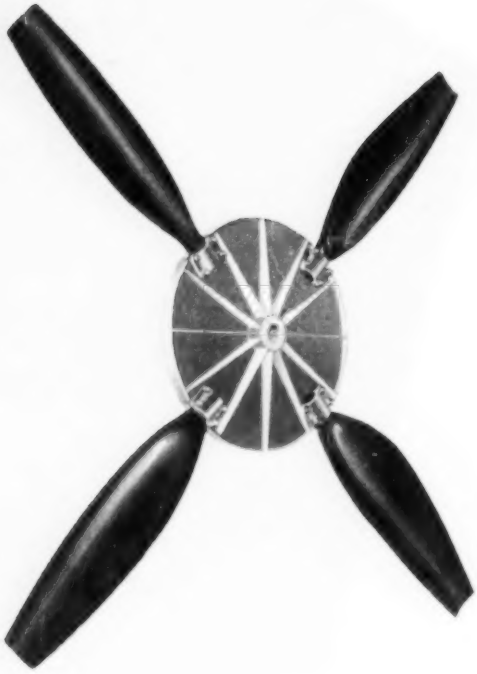
HARTZELL cooling tower fans last a long, long time*



12′ adjustable four-blade fan. Blades of Hartzite plastic.

6′ adjustable six-blade fan. Blades of aluminum alloy.

The blade materials in all Hartzell cooling tower fans are chosen to resist the specific destructive factors which will be encountered in fans of a certain size. Smaller size fans (3′ to 9′) have aluminum alloy blades to provide maximum physical strength in a smaller blade. And on these smaller fans the cast aluminum hub gives a combination of lightness and strength.

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*Practically all Hartzite units installed since Hartzite was originated in 1941 are operating satisfactorily today.

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Other Platt Petroleum Publications

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The weekly oil marketing magazine, covering news prices, transportation, storage, merchandising.

Platt's Oilgram News and Platt's Oilgram Prices
A daily independent oil-news and oil-price reporting service issued from New York, Cleveland, Houston.

January, 1952
Vol. 7, No. 1

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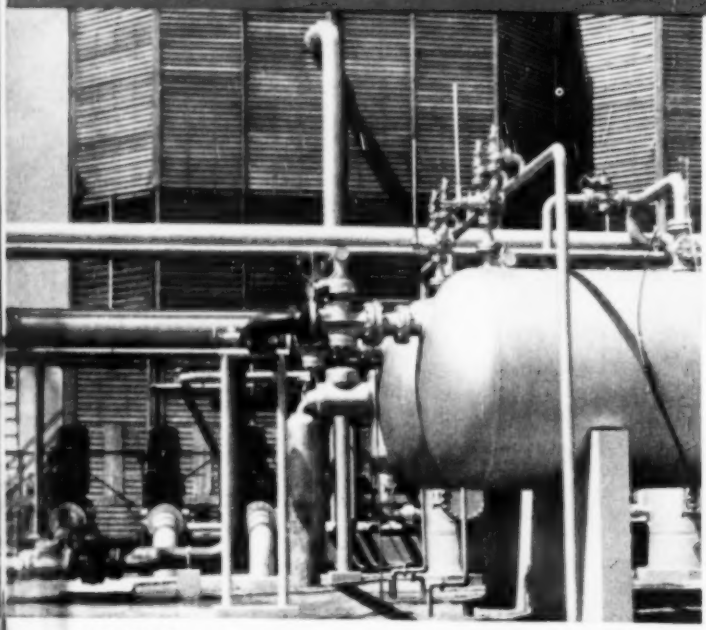
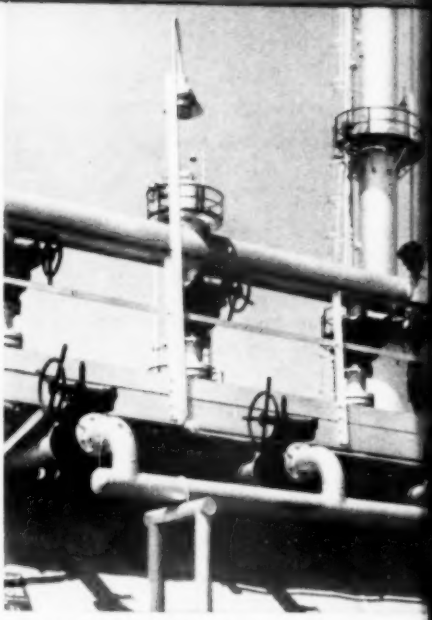
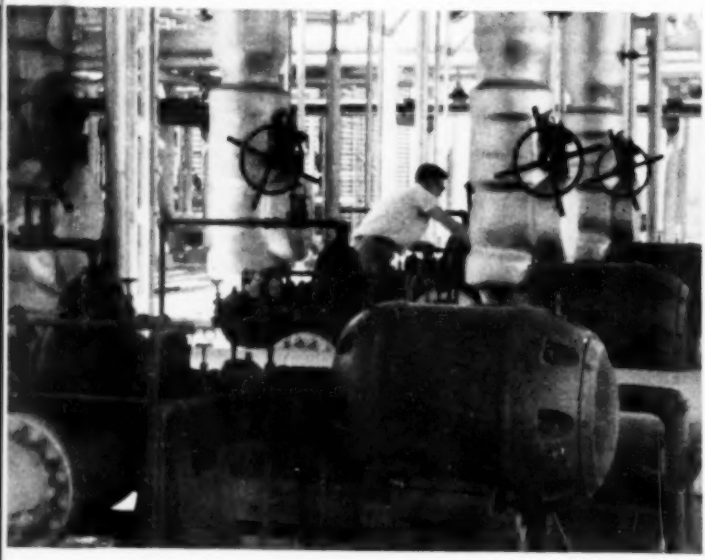
Q: Where are Nordstrom Valves



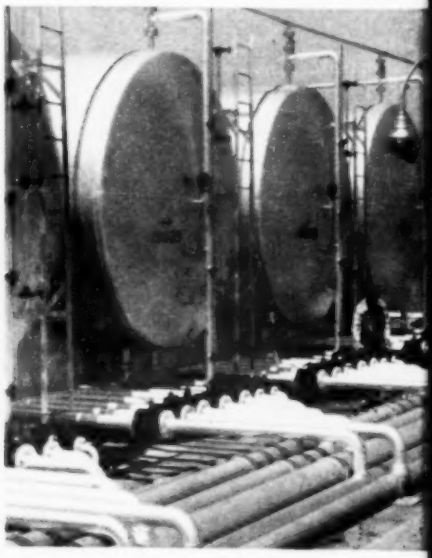
TREATERS— Manifold of Nordstrom valves on Ferco gasoline treaters which take hydrogen sulphide and other impurities out of gasoline.



COOLING TOWERS— Lines carrying gas vapors to debutanizer overhead cooler are fitted with Nordstroms.



PUMP LINES— Insulated Nordstrom valves used on pump intake and discharge processing lines.



TANK STORAGE— Battery of Nordstrom valves control flow of gasoline, butane, and propane from storage to loading racks.

Used in a Gasoline Plant ?

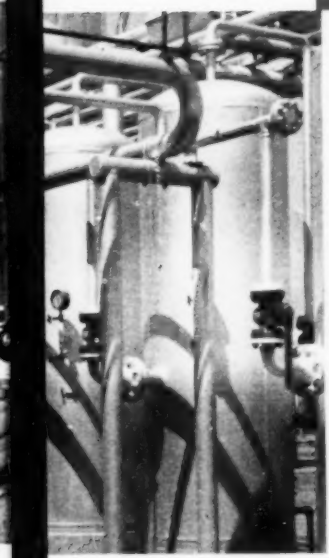
For the varied services in a gasoline plant Nordstroms are by far the most commonly used valves. Typical locations for Nordstrom valves are debutanizer, instrument, pump, dehydrator, scrubber, separator, treater, absorber, lean oil, deethanizer, oil heater, cooling tower, metering, compressor, gathering, storage and loading rack lines, to mention only a few.

Because Nordstrom valves are built for all pressure-temperature conditions encountered in a gasoline plant, because the range of Nordstrom sizes, materials and body styles is the most complete obtainable, because Nordstroms stay tight in service on hard-to-hold gases and petroleum derivatives, most of today's most efficient gasoline plants have standardized on Nordstrom lubricant sealed valves.

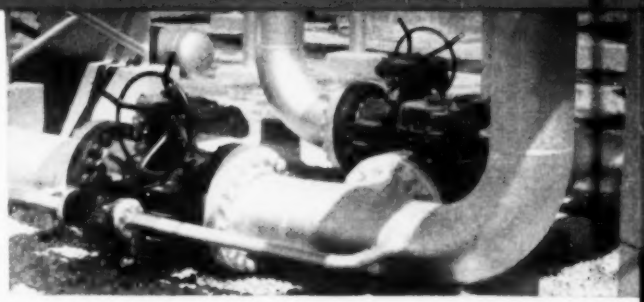
Here are just a few examples of the hundreds of Nordstrom applications in a *single Oklahoma gasoline plant.*

Where are Nordstrom Valves used in a Gasoline Plant?

A: Everywhere!



INSTRUMENT AIR LINES — Nordstrom valves on lines carrying instrument air to the air starting tank.



SURGE LINES—Rich oil from absorbers flows through these Nordstrom equipped lines to rich oil surge tanks for mixing.

Nordstrom Valves

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WHAT'S HAPPENING

Current News Summarized For Oil Men

Expansion

More refining capacity is the only outlook for the industry—nearly 400,000 b/d more by the end of 1952 according to PETROLEUM PROCESSING's estimates.

Last month the Bureau of Mines predicted that total demand for all oil products in the U.S. during 1952 would average 7,841,000 b/d, or 378,000 b/d over estimated 1951 demand.

About 360,000 b/d of that added demand will have to be met by refinery output, in our opinion. And based on a 90% rate of operation (the current rate), it will take 400,000 b/d of new capacity to do the job.

Total operating capacity at the end of 1951, API estimated, was about 7,228,500 b/d, up 526,685 b/d from the level reported at the start of the year.

Expansion of HD lube oil facilities by 15,000 b/d and at a total cost of about $25 million has been approved by Defense Production Administration, thus clearing way for approval of applications for rapid tax write-offs. Also approved has been PAD program for expanding lube oil detergent additive output by 10 million lbs. annually, at estimated cost of $10 million.

Shamrock Oil & Gas Corp. will install first commercial unit of the new Lummus Continuous Contact coking process at its 7,500 b/d Sunray, Texas refinery. The unit is being built by Lummus Co. and completion is expected by mid-1952. In the process a stream of hot coke is continuously contacted with a preheated oil charge to build up coke particles. Those of desired size are drawn off as dry lump coke.

Republic Oil Refining Co. plans to start construction soon on a $7 million expansion of its Texas City, Texas refinery which will almost double existing 35,000 b/d crude throughput. Program calls for a 30,000 b/d UOP Platformer, and office, dockage, tank and power plant facilities. Platformer, which will make aromatics and high quality motor gasoline, is scheduled to be completed by mid-year, with other facilities to be built subsequently.

Continental Oil Co. has announced $7.5 million expansion program for its Ponca City, Okla. refinery, to be completed in about 18 months. Contracts have not been let. Included are $3,550,000 continuous contact coker unit, $2 million lube oil additives plant, turbo-generator, and high-pressure boiler and other power plant equipment. This is the second major expansion at Ponca City since 1948, bringing the total to more than $15 million.

Midland Cooperative Wholesale is planning to increase capacity by 4000 b/d at its 6000 b/d Cushing, Okla. refinery, plans calling for installation of catalytic cracking to replace existing thermal cracker. Universal Oil Products Co. is making engineering studies, to be completed by Feb. 1, 1952.

Cooperative Refinery Assn. will double crude throughput at its 4000 b/d Phillipsburg, Kans. refinery to 8000 b/d and install a 5000 b/d Fluid catalytic cracking unit as well as a polymerization unit. The Refinery Engineering Co., Tulsa, has contract, which calls for completion by February, 1953. Engineering now is under way.

Tide Water Associated Oil Co. will replace existing facilities at its 12,000 b/d (rated capacity) Drumright, Okla. refinery with a new 15,000 b/d crude distillation unit, including both atmospheric and vacuum distillation sections. Company states this will not increase present total capacity. Born Engineering Co., Tulsa, has contract, work to start early in 1952 and scheduled for completion before the end of 1952.

Imperial Oil Co. Ltd. will increase capacity of its Vancouver, B. C. refinery from present 12,000 b/d to 22,500 b/d as a consequence of approval given Trans-Mountain Oil Pipe Line Co. to construct $80 million, 695-mile, 24-in. crude line from Edmonton, Alta., to Vancouver. Line's initial capacity will be 75,000 b/d, with ultimate capacity of 200,000 b/d. Total crude charging capacity in Vancouver area is 29,000 b/d. Three other companies in the area are known to have been considering expanding their refining facilities if and when Alberta crude became available, but no decisions have been announced.

General Petroleum has launched a $528,000 improvement program at its Torrance, Calif. refinery to increase production of avgas components. Included is a distillation tower once ear-marked for Russia (as part of a complete avgas plant whose shipment was cancelled in 1945). GP engineers, who located the tower, claim a saving of 200 tons of steel by using it. J. B. Gill Co. has contract.

Petrochemicals

Phillips Chemical Co., subsidiary of Phillips Petroleum Co., is taking over petrochemicals project which Alamo Chemical Co. had planned near Phillips ammonium sulfate plant on Houston Ship Channel, by acquiring all interests in Alamo held by Borden Co. and General Aniline & Film Corp. Originally, facilities were to produce ammonia, methanol and other chemicals from petroleum raw materials; now they will serve as basis for manufacture of "wide variety of petrochemicals." Construction is being started immediately.

Pittsburgh Consolidation Coal Co. will build a large pilot plant at Library, Pa., to further company's work on low-temperature coal carbonization, particularly cost and design data for a commercial plant and production of sufficient quantities of products to permit commercial evaluation of the many chemicals and spe-

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

rial carbons to be obtained. Chemical Plants Div., Blaw-Knox Co. has construction contract, with completion scheduled for late 1952. (More details on coal carbonization in this issue, p. 45).

Ethyl Corp. will complete this year at Baton Rouge a major addition to its capacity for producing benzene hexachloride (BHC). Production will be chiefly high gamma BHC and the lindane grade most valuable as insecticides. BHC is made by the chlorination of benzene in the presence of actinic light.

Union Carbide & Carbon Co. has received a fast tax write-off certificate for a proposed experimental coal hydrogenation plant of 300 tons/day, to be built in Kanawha Co., W. Va. Project is estimated to cost $11 million, and would produce benzene, toluene and light oils, with emphasis on chemicals—not fuels.

Markets, Prices

Refined products were tight, generally speaking, as the last month of 1951 ended, and prices for the principal items in most refinery and terminal districts were firm at ceiling levels reached late in Dec. 1950. Spotty retail gasoline price wars and continued easiness in some specialty products were all that marred an otherwise "bull market" for oil. Worst of the retail gasoline price wars was in Chicago, where postings for major brands of regular-grade had dropped at many service stations the last week in December to 12.9c gal. (ex 6c taxes), or 8c below so-called "normal."

Paring down of high inventories of distillate fuels which had accumulated in primary storage began late in December as a result of a cold wave which blanketed the area east of the Rocky Mountains. There was plenty of product to go around, but despite this fact primary sellers were not disposed to deal with other than their regular customers of record. Such spot shortages as developed—and they were few—resulted from impairment of transportation facilities by snow-blocked highways and railways in the middle west.

Heavy fuel was perhaps tightest product in the refined oil lists, especially in coastal districts. There were a number of contributing factors: (1) a South American inquiry for 2 million bbls. over the first 6 months of 1952; (2) the short position (3 million bbls.) of one large marketer over first quarter; and (3) the increase in Liberty and Victory ships put back into service to carry ECA dry cargo to Europe.

LP-Gases followed a seasonal pattern of extreme tightness, and prices—the ceilings of individual manufacturers and other suppliers—covered a wide range. For propane, FOB Group 3, the principal manufacturers quoted 4c/gal. Suppliers with higher ceilings disclosed sales at prices more than twice this figure.

Industrial Mobilization

Steel allotment of 2,141,988 tons for second quarter has been requested by PAD. Bulk of this is carbon steel, of which 151,200 tons would be for refining, 78,776 tons for natural gas processing (including LPG), and 99,583 tons for MRO supplies. In addition to carbon steel, PAD request includes 122,657 tons of alloy steel and 8,368 tons of stainless—most of which would presumably be for processing.

Critical copper shortage may require refiners to substitute other metals, such as aluminum, for current copper uses. Copper is expected to be even harder to get during second quarter than it now is, and PAD plans to ask industry for suggestions and cooperation pointing to substitutions. PAD is moving with caution, however, prompted by two questions: How much aluminum will be available? How widely can substitutions be made without impairing plant operational efficiency?

Output of compressors is expected to drop about 45% below fourth quarter 1951 rate of production because of reduced first quarter copper allotments—unless supplemental allotments are made by National Production Authority.

How much scrap from replaced equipment will be made available to scrap dealers is now being taken into account by PAD in approving major projects involving purchases of controlled materials. In the past, PAD has given priorities assistance on the basis of the essentiality of a project. "Now," Deputy Administrator Bruce K. Brown said last month, "we face a situation in which we must also take into consideration what the project may be able to contribute to the collection of needed scrap.

"We are faced by some hard facts: No scrap, no steel. No steel, no oil or gas. We have to give thought and time and effort to getting every pound of available scrap into the steel mills so production can be kept high."

Increased naphthenic acid production is being sought by PAD, which last month sent a survey to 35 refiners in the country to determine what they might contribute to output. It is estimated an additional 12,000,000 lbs./yr. could be absorbed by the market. Most naphthenic acid at present comes through recovery from caustic solutions that have been used in washing straight-run distillate fuel oils.

APPOINTMENTS—Walter C. Huffman, as Asst. Director of PAD's Refining Division; he has been with PAD since Oct. 1950, and prior to that was with Sun Oil . . . **E. Carl Mattern,** former district director of Oil Workers International Union, as Asst. Deputy Administrator of PAD . . . **Francis J. Cahill** (Aramco), as special assistant to **George T. Ballou,** director of PAD Foreign Refining Division . . . **Col. W. J. Worcester,** former deputy executive officer of Munition Board Petroleum Committee, as PAD aviation fuels officer . . . **Dr. Floyd L. Miller,** director of Standard Oil Development's research division, as vice chairman of Defense Department's Research and Development Board . . . **Brig. Gen. Alfred H. Johnson,** USAF, as chief, petroleum programs, and executive secretary, Munitions Board Petroleum Committee; he replaces **Rear Adm. Burton B. Biggs,** USN, who will shortly take over an important new assignment in Far East.

William W. Keeler (Phillips Petroleum) is expected to replace **C. E. Davis** (Shell) as director of PAD's Refining Division April 1. Davis is to take over from **A. P. Frame** (Cities Service) as Asst. Deputy Administrator in charge of domestic operations.

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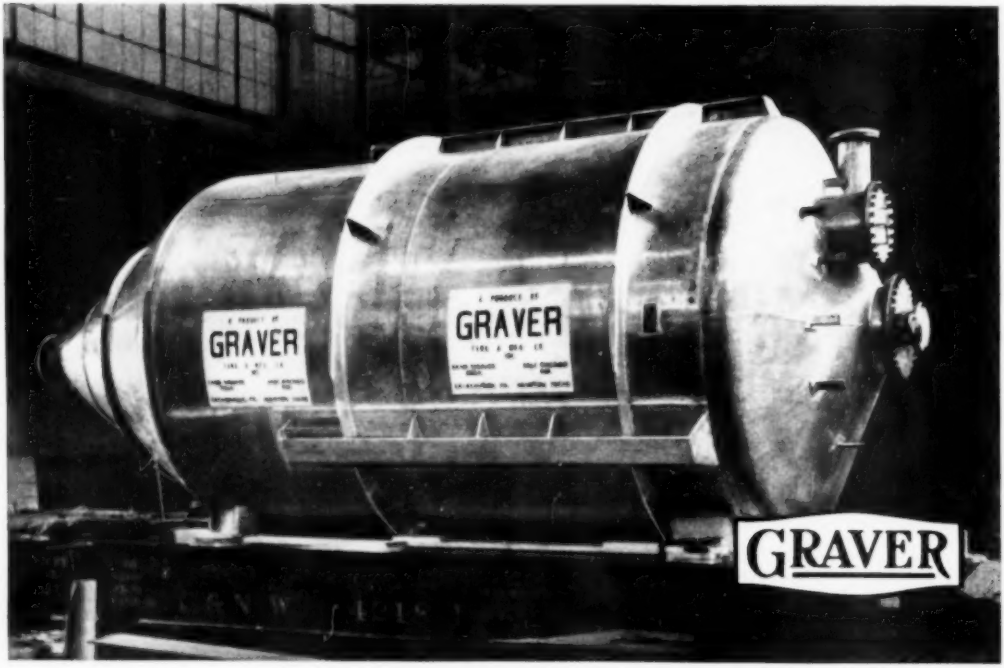
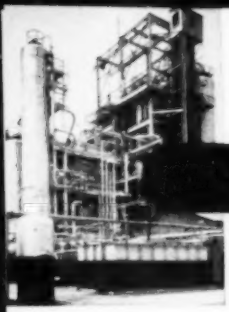
Aluminum Bin — 12' dia. x 31'3" long fabricated by Graver for Gulf Coast chemical plant





TOMORROW... IN PETROLEUM TECHNOLOGY

Possible Effects of Today's Developments On Future Operations

By the Editors of Petroleum Processing

Continued Phenomenal Growth For LP-Gas Is Indicated

THE Phillips Petroleum Co. report for 1951 on the liquefied petroleum gas industry is again one of phenomenal growth, its sales being nearly 26% larger than for 1950.[1] A relatively increasing consumption during the summer off-peak demand months, together with the fact production capacity is only about 16% greater than the year before, makes the present supply situation "very tight, with many indications pointing to another winter shortage."

Phenomenal though the growth of LPG has been, it is generally accepted that lack of adequate storage has made it impossible to balance supply with demand conditions in winter months and has thus been a handicap on the industry's development. "This unbalanced supply versus demand condition is influencing larger storage at all stages of distribution channels. The results of this influence can make it possible for the industry to balance its supply and demand in a reasonable period of time."

Storage has been a major problem because of the relatively high cost of pressure-type steel storage. However, many producers now have programs under way for adding to their primary storage capacity. "The types which presently offer the best solution are the underground storage caverns. These may be washed in salt beds or domes, or may be mined in suitable limestone or shale formations and have capacities up to 100,000 bbls. or more." The full effect of these storage projects cannot be fully realized until the 1952-53 winter.

Direct motor fuel use of LPG continued its previous rapid gain in 1951, although its actual gallonage is difficult to estimate, due to the varied use for the product at many consumer installations. Use as direct motor fuel includes use in farm tractors, trucks, buses and taxi-fleets. The large potential market for direct motor fuel use of LPG is regarded as "barely touched. However, the great interest shown throughout the country by countless companies and individuals interested in fuels and engines indicates a vast future market for direct fuel use." —V.B.G.

(1) "Review of LP-Gas Marketing for 1951." K. W. Rugh and George R. Betz. Phillips Petroleum Co.

Principle of Cyclone Separator Applied to Liquid Streams

THE advent of fluid techniques in catalytic cracking probably has had more to do with familiarizing the oil industry with the cyclone separator than any other one processing operation. The device in many forms had of course long been used by various other industries to separate fine solid particles from gas streams.

Now the same principle has been applied to separating solids from liquid streams. During World War II the first liquid cyclone was developed by the Dutch. Two years ago the idea migrated across the Atlantic and currently at least five firms in the U. S. are selling them to American industry.[1]

As yet the liquid cyclones have been used only in coal and other mining applications, degritting slaked lime and clay, and in desliming rock phosphate. But the oil industry might find considerable application for them in concentrating the solids from liquids for separate disposal of plant wastes, and in removing fine particles of coke from the water used in hydraulic decoking. Another possible application is in separating mixtures of liquids having different specific gravities.

Still another application which has been suggested is the separation of crystals from the mother liquor, but an answer to whether or not this would be attractive in dewaxing operations first needs considerably more investigation.

It is reported that a high-efficiency cyclone will recover 97% of the coarse particles from an underflow containing 70% solids; 90% of the fines are removed in the overflow. Using a second such cyclone in series with the overflow will remove fines down to the 10 micron range. —D.P.T.

(1) "Purge in Liquid Cyclones." Chemical Week, Dec. 15, 1951, p. 51.

Amyl Nitrate Shows Promise As Diesel Fuel Additive

WHILE it is generally known that the ignition-quality ratings of diesel fuels can be improved by the addition of small amounts of amyl nitrate, recent work by the Ethyl Corp. Research Laboratories has shown that beneficial effects for full-scale engine operation are realized from the improvement in ignition qualities.[1]

"The requirement of any diesel engine for fuel ignition quality is dependent upon its operating conditions," it is stated. "Ignition quality of a diesel fuel and the temperature and pressure of air in the combustion space of a diesel engine at the time of fuel injection determine whether the fuel ignites and how it burns when it does ignite."

The economic significance of establishing the relationship of ignition quality and general fuel performance is apparent particularly if the ignition-quality improvement can be secured by means of a low-cost additive used in small quantities.

"A consideration of modern refinery trends and the demands for all petroleum products leads to the conclusion that the distillates from the cracking processes are rapidly becoming an important source of supply for diesel fuels in many parts of the country. By comparison with straight-run distillates from the same source of crude oils, it has been observed

that the cracked stocks have a lower pour point and a higher heating value per gallon. These are outstanding advantages for their use as diesel fuel.

"However, the same comparison shows that, in general, some cracked material is lacking in ignition quality. This quality can be supplied by the addition of a small amount of ignition accelerator. In this way the supply of diesel fuels can be increased appreciably, better uniformity of fuels can be achieved and blending can be done with a consideration for other important fuel properties."

To become commercial, it is pointed out that an ignition accelerator must have a low cost for a given gain in cetane number because it must compete with other methods for improving ignition quality which are presently in use. Of nearly 500 compounds investigated by Ethyl Corp.'s Research Laboratories, the cost per cetane-number gain was so high almost all were excluded from further study. —V.B.G.

(1) "Effectiveness of Amyl Nitrate in a Full-Scale Diesel Engine" by M. J. Anderson and G. C. Wilson, Ethyl Corp. Research Laboratories, before SAE National Fuels Engine Meeting, Chicago, Oct. 29 to 30, 1951.

Radioactive Tracer Techniques Used in Refining Research

DISCUSSION of the use of radioisotopes in oil company research thus far has been largely confined to their application in automotive laboratories for testing engine wear. In fact, radioactive tracers were used for this purpose by Atlantic Refining Co. investigators before radioisotopes became available to scientific investigators through the work of the Isotopes Division at Oak Ridge of the Atomic Energy Commission.(1)

The specificity, sensitivity and versatility of isotopes is now seen opening up a particular field of usefulness in refining research. Here, among other purposes, they can be used as tracers in following a particular process or flow stream, according to a spokesman for the Atomic Energy Commission.(2)

"It is possible," states this authority, "to label one type of hydrocarbon, for example the naphthenes (or unsaturates, paraffins, sulfur compounds, etc.) and to study its distribution between two solvents in the presence of the multitude of other compounds found in petroleum. One is resonably sure that measurements of radioactivity pertain specifically to the compound originally labelled."

Application to solvent refining is also indicated by this same author. Quantitative analysis in a mixture of hydrocarbons containing deleterious substances such as mercaptans is described as being made much more readily by detecting the radiations from S-35 used to label the molecule. Likewise, catalytic reforming, the adsorption phenomena associated with the use of decolorizing clays, the interpretation of "oiliness", the life of catalyst beads and many other such problems may be studied by the radioisotope technique.

It is in the fields of reaction mechanism and reaction kinetics that the value of the radioisotope technique is considered most promising. Carbon-14, for example, has been applied in the study of the mechanism of the Fischer-Tropsch synthesis. "The actual mechanism has been in doubt for some time; one theory postulated the formation of iron carbide as an intermediate in the reaction; according to a second theory, the catalyst offered a suitable surface at which the reaction could take place but did not of itself assume any other role." Tests with carbon monoxide, tagged with radioactive carbon and passed over an inert mixture of iron and iron carbide showed that the "greater part of the synthesis reaction proceeded by some process other than by reduction of carbide as an intermediate." —V.B.G.

(1) "Some Phenomena of Engine Wear as Revealed by the Radioactive Tracer Technique" by D. R. Jackson, F. C. Hurt, L. J. Test and A. T. Colwell, Atlantic Refining Co., SAE National Fuels and Lubricants Meeting, Chicago, Oct. 30-Nov. 1, 1951.

(2) "The Availability of Radioisotopes and Their Application to Petroleum and Automotive Research," by Thomas V. Marsh, Chief, Advisory Field Service Branch, Isotopes Division, Atomic Energy Commission, Oak Ridge, Tenn., SAE National Fuels and Lubricants Meeting, Chicago, Oct. 30-Nov. 1, 1951.

Your "Erl" Starting to "Berle?" Television May Be the Answer

INDUSTRIAL radio may mean soothing music and the latest news being brought to all plant employes by public address systems. But industrial television does *not* mean putting a TV set in front of every worker for entertainment during his "dreary" daily working day.

Industrial television, however, is a promising new tool with potential possibilities for improving processing operations.(1, 2) Unlike its commercial counterpart which has such obvious uses, industrial TV is only beginning to find a niche for itself. The earliest example of non-commercial TV was for the military. Bombardiers checked their target-hitting ability by watching the "show" on a receiver screen in the bomber, picked up by a TV camera in the falling bomb itself. This unit was, of course, wireless. Subsequent developments have been with wired sets, using cable connections usually.

Most successful current application is checking water level in huge boiler plants (one manufacturer has sold 100 of these). A very critical safety factor in boiler operations, water level is still best checked by the conventional gage glass. However, size of many boilers puts the glass at a tremendous distance from the operator. Remote indicators, tried for a while, proved unreliable (two serious accidents resulted from their failures). Answer has been to put a TV camera at the gage glass and a receiver on the control panel.

Initial cost is not low for industrial TV, but may go down. Typical current price for a camera-receiver set with no extras is $1200 although many sets require accessories and special design, so cost can be greater. Operating costs are good, however, 2 to 4c per hour. Main reason is use of a long-life camera tube (9000 hrs. continuous service) as compared with the commercial camera tube (700-900 hrs. intermittent service), with price on either tube about the same —$1200.

Imaginative engineers in the petroleum processing industry will undoubtedly find much that is fascinating and likely ultimately useful in this baby cousin of today's most tremendous entertainment development. —W.C.F.

(1) Fortune, September 1951.

(2) "Industrial Television" by G. H. Wilson, Diamond Power Specialty Corp. presented at Dec. 12, 1951 meeting Instrument Society of America, Cleveland Section.

More and more sales

Monsanto has increased its production of Santodex, the viscosity index improver for lubricating oils. This helps you increase your sales—helps you gain the profit-making advantages of dual grading.

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To obtain more data on advertised products see page 104

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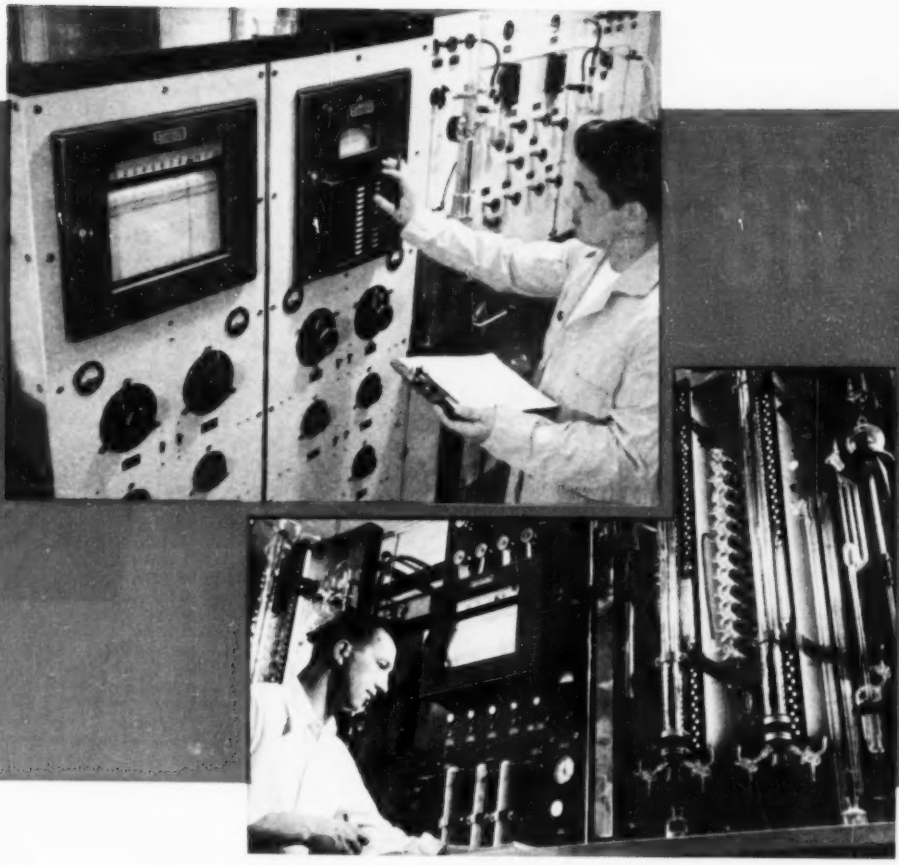
BROWN Instrumentation
. . . is patterned to the exact requirements of individual plants and processes . . . is the result of engineering and application know-how, with one responsibility from sensing elements to control valves . . . is backed by a nation-wide field engineering and service organization.



PROVING processes in the pilot plant stage can save untold millions of dollars in "on-stream" operations. But bridging the gap between fluid ounces per hour in the laboratory and hundreds or thousands of barrels per hour in the plant takes considerable doing.

Thorough instrumentation in the pilot plant provides . . . (1) *a saving in scientific man-hours*, through the centralization of critical data which eliminates the hand logging of hundreds or even thousands of points . . . (2) *easy and rapid interpretation of data*, through automatic coordination and recording in chart form . . . and (3) *process simplification*, through a complete understanding of control problems well in advance of full-scale operations.

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LETTERS

Tank Painting Problems

The article ("How to Cut Tank Painting Costs" PETROLEUM PROCESSING, November, 1951, pp. 1254-61) is very informative—so informative in fact that I believe anyone reading it can set up a duplicate spray painting system and would likely attain a similar economic advantage over that obtainable with brush painting.

Some question exists in my mind as to the economics of using four coats of paint, but the overall cost figures are so good I hesitate to question them. Things the article didn't give any information on are:

1. How the refinery management persuaded the probably unionized painters to substitute spray painting for brush painting, and

2. How was spraying of the nearby neighborhood avoided . . .

Name withheld by request

James F. Goldsberry, chief engineer, Shell Oil's Wood River, Ill., refinery (source of the tank painting article), answered this inquiry:

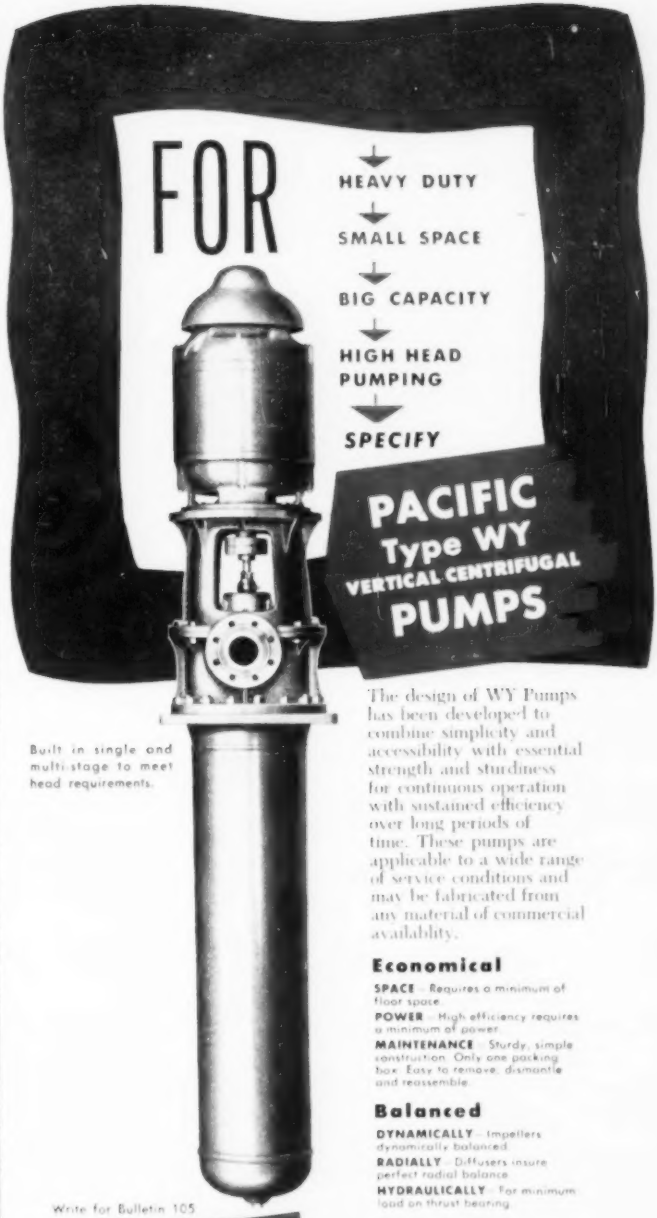
". . . the four-coat paint system is employed to achieve greater coating life. The major portion of cost on the average job is surface preparation, and additional coatings can be applied at a comparatively low figure. The economics indicate that a four-coat system is justified.

"Spray painting has been a practice followed by our painter craftsmen since maintenance painting was started at the plant. Formulation of a sprayable primer with suitable inhibitive characteristics to eliminate brush painting on tanks and other adaptable surfaces is the cost reducing innovation.

"The paint overspray flight problem is serious and ever present, especially with regard to automobiles on plant parking lots. A constant watch is maintained on wind direction and spray gun adjustment to eliminate paint deposits on nearby surfaces. Minimum gun pressures and operation at 10 to 12 in. distance from the surface being coated have done much to mitigate this problem."

Synthetic Fuels

Your article ("Outside Engineering Firm to Audit Bureau's Synthetics Cost Data," Dec., 1951 PETROLEUM PROCESSING, pp. 1380-81) is a fine review of the cost-study position of synthetic fuels. Nobody that is studying the problem will deny that the synthetic fuel industry will be one of the very large industries of the future. The discussion between the petroleum industry and the Department of the Interior is primarily one of timing. Oscar Chapman is charged with the responsibility to see that liquid fuels are continually available to us Americans in the quantities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Built in single and multi-stage to meet head requirements.
The design of WY Pumps has been developed to combine simplicity and accessibility with essential strength and sturdiness for continuous operation with sustained efficiency over long periods of time. These pumps are applicable to a wide range of service conditions and may be fabricated from any material of commercial availability.
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SPACE — Requires a minimum of floor space.
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DYNAMICALLY — Impellers dynamically balanced.
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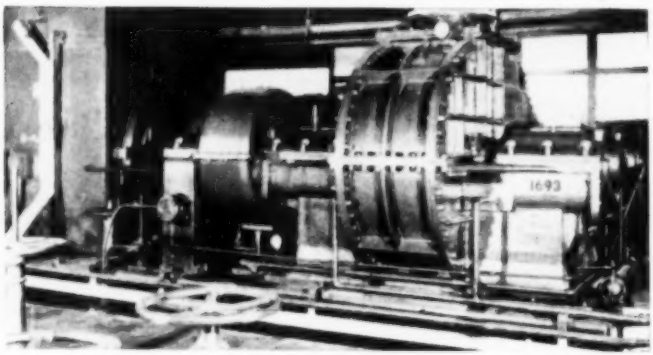
(To obtain more data on advertised products see page 104)

NEW R·C EXHAUSTER
pays its own way

By replacing a 30-year-old battery of three steam-driven gas exhausters with a new, high-capacity, electrically-driven R·C unit, important advantages were gained, in a large industrial plant:

1. **The one new unit carries the base load.**
2. **Steam needed for 5 other steam-driven exhausters, carrying partial load, is substantially reduced because of slower speeds.**
3. **Heat balance in the plant is maintained.**
4. **Savings in total power cost will pay for the new installation in about one year.**

These very satisfactory results were obtained by careful evaluation of all the factors before deciding upon the type of equipment . . . and then by specifying an R·C Rotary Positive Gas Exhauster that will do the work at low operating cost.



Type RCGH Rotary Positive Gas Exhauster, driven by 450 hp synchronous motor. Capacity, 20,600 cfm.

Even though your equipment to handle gas or air may still have years of life, it may be sound economy to replace it with modern, efficient, R·C units of the right type, size and drives to best meet your needs. Our engineers will help you analyze your problem and make unbiased recommendations of either Rotary Positive or Centrifugal equipment, depending upon your specific conditions. This *dual choice* is an exclusive R·C advantage.

With capacities from 5 cfm to 100,000 cfm, R·C units can be closely matched to work requirements, for dependable, economical performance. At Roots-Connersville, almost a century of blower building experience is at your service, without obligation.

Type OI Centrifugal Blower in oil refinery operation. Capacity 11,750 cfm.

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that we require. The oil industry must make these fuels available.

The timing centers, of course, on the cost of synthetic fuels. The Bureau and industry have announced figures that seem far apart, but really are close together. The Bureau's figures are direct cost figures, and the industry includes capital cost and off-site costs, both of which the Bureau will admit are legitimate costs. The Bureau will not admit that these capital costs and off-site costs are as high as industry puts them; i.e., 6% return on all capital invested. Price, Waterhouse says they should be higher; i.e., 15% return on all capital invested. Most of us feel that the actual figures belong between the Bureau's estimate and Price, Waterhouse's recommendation, probably because part of the capital would be equity capital for which 15% would have to be paid as recommended by Price, Waterhouse, whereas the remainder would be low-interest borrowed capital. Many of the off-site facilities also will be built by outside capital but probably not without underwriting by industry.

I expect Ebasco to come up with some compromise analysis indicating possible methods of financing so that the return on the over-all amount of capital expended will be lower than 6%, and perhaps including suggestions concerning off-site facilities. The analysis therefore will show costs of gasoline from coal by hydrogenation less than 13¢ a gallon, but still far greater than present prices. However, the analysis may indicate that one coal hydrogenation plant for the production of chemicals may be economic with a government guarantee of prices.

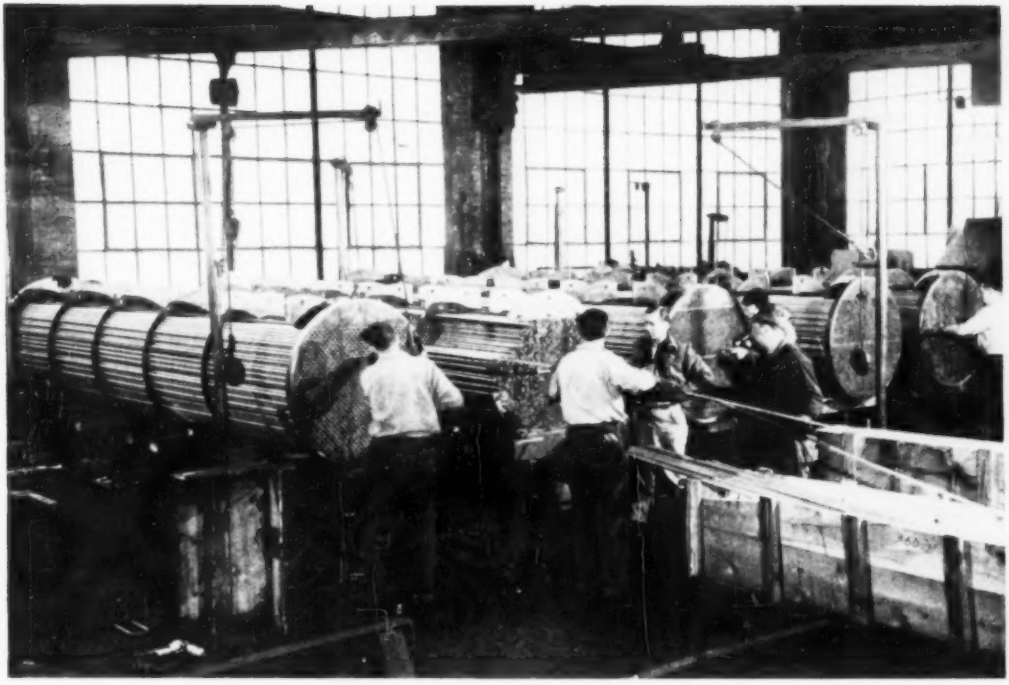
The differences are ones of degree not of kind and because so little is known of the technology of producing synthetic fuels, both sides are probably equally as close to the truth.

Prof. Tell Ertl, Chairman
Dept. of Mining and Petroleum Chemistry
The Ohio State University

Correction on Alloys

In the article "Beating the Alloy Steel Shortage," p. 1361, December, 1951, issue of PETROLEUM PROCESSING, it was stated that the tentative emergency standards for five grades of chromium-molybdenum steels proposed by the API Interim Advisory Committee on Alloy Steels had been put before the PAD in Washington. That statement was in error. The Committee advises that the tentative standards have not been submitted to PAD, pending their further consideration by the Committee and by the industry.

(To obtain more data on advertised products see page 1041)



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A mixture of steam, hydrocarbon vapors and inert gases will enter the condenser shells at 265 F. and exit at 120 F. Fresh water from a cooling tower will enter the tubes at 95 F. and 4 ft. per sec. velocity.

Severe corrosive or erosive action on either hydrocarbon or water side is not anticipated. ANACONDA Arsenical Admiralty Tubes conform to specifications requiring Admiralty, which is characterized by Kellogg's engineers as most economical for this job.

They say: "*Admiralty has proved over the years to be the best tube material for mild corrosive conditions . . . In the past 20 years a very substantial majority of all tubes used have been inhibited Admiralty.*"

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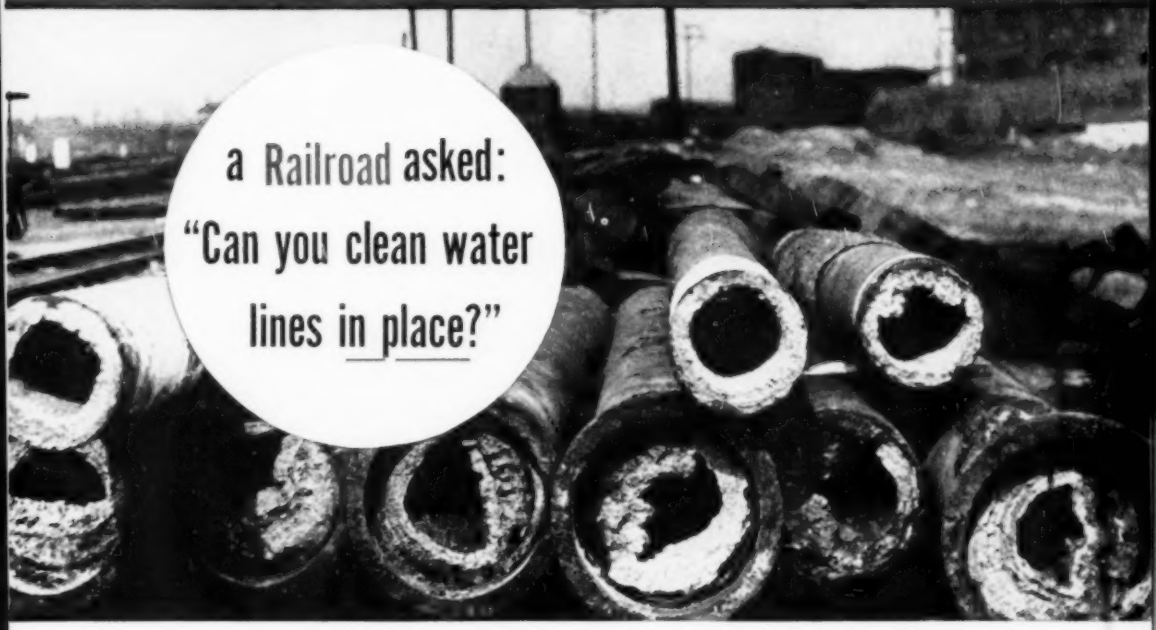

Dowell Service cleaned over 8600 feet of buried water line in six days!

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Dowell Service offers *fast*, effective cleaning of pipelines—underground or above, indoors or out. No digging or dismantling is necessary. Dowell liquid solvents, designed to dissolve the accumulated deposits, are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water flow, cleaning places inaccessible to other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job, using Dowell-designed, truck-mounted pumps, mixers and control equipment.

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Air cooling system on two 22,500 K.W. generators cleaned for Midwestern Utility company in four hours. Before Dowell Service, the operating temperature of the generator was at the maximum allowable of 60° C. After service, the temperature was a normal 50° C.

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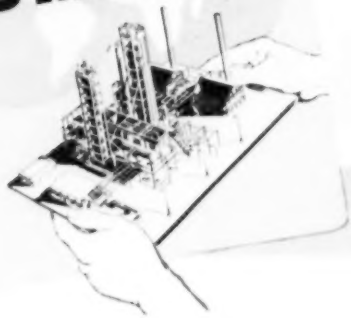

The Lummus Company has played an integral and important role in the unfolding story of chemical progress.

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1. Caustic soda of high purity, low in iron and sulfates . . .

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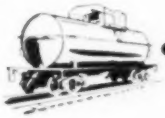

2. Modern equipment for loading and shipping to maintain that purity from our plant to the user's plant . . .

+

An experienced technical service staff to help you use and handle caustic soda.

To you this means minimum processing costs through elimination of variations in quality from shipment to shipment. To make sure that Hooker Caustic reaches you as pure as it leaves us, we coat Hooker tank cars with a special protective lining. Each car is completely insulated and equipped with a heating device to make handling and unloading uniform the year around.

+ You can reduce processing costs further through the safe and efficient handling of caustic soda. This is where the specialized knowledge of our technical service staff can help you.

For analyses and specifications on Hooker Caustic Soda, write on your business letterhead for Technical Data Sheet No. 735.

Hooker Caustic Soda is sold in solid, flake or liquid form. Liquid is supplied in 50% and 73% concentration.

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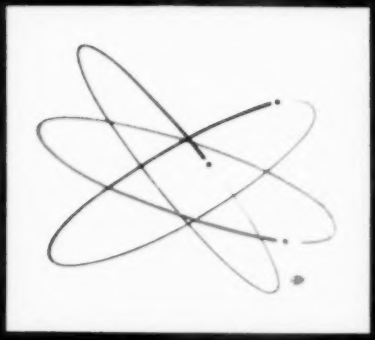
NEW YORK, N. Y. • WILMINGTON, CALIF. • TACOMA, WASH.

1-1248

SODIUM SULFIDE • SODIUM SULFHYDRATE • SODIUM BENZOATE • CHLORINE • MURIATIC ACID • PARADICHLOROBENZENE • MONOCHLOROBENZENE

instantaneous *all-electronic control*

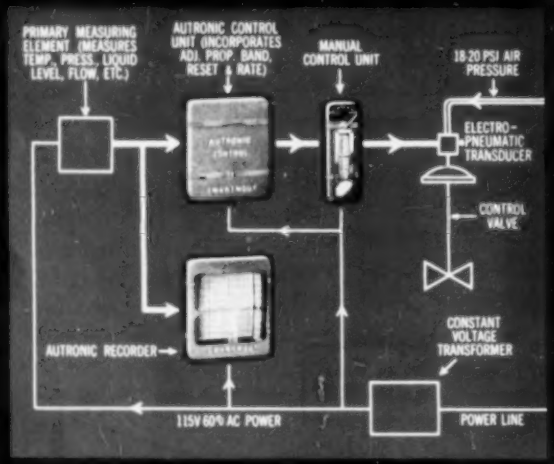


of pressure

temperature

flow

and level . . .

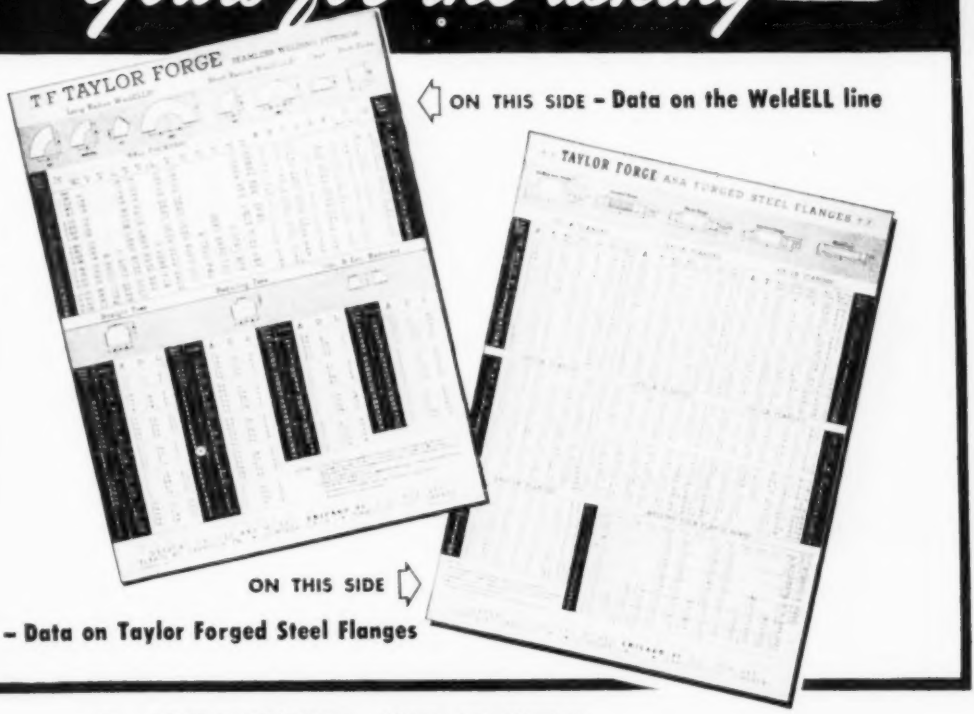

PRIMARY MEASURING ELEMENT (MEASURES TEMP., PRESS., LIQUID LEVEL, FLOW, ETC.)
AUTRONIC CONTROL UNIT (INCORPORATES ADJ. PROP. BAND, RESET & RATE)
MANUAL CONTROL UNIT
18-20 PSI AIR PRESSURE
ELECTRO-PNEUMATIC TRANSDUCER
CONTROL VALVE
AUTRONIC RECORDER
CONSTANT VOLTAGE TRANSFORMER
115V 60% AC POWER
POWER LINE

The new Swartwout Autronic Control System brings new speed, new accuracy to your process controls. Without mechanical motion of any kind this new *all-electronic control system* spans distance between primary element and control element *without interval*. Measuring . . . analyzing . . . correcting —the Autronic System keeps your process on stream . . . assures quality product by controlling pressure, temperature, flow and level properly, instantaneously *without cycling, drifting, shifting*. Call in our engineering representative to explain how Swartwout Autronic Controls will bring new accuracy to *your* process and power instrumentation and control. Or write *today* for literature on the new Swartwout Autronic Control System.

Swartwout *Autronic* **CONTROL SYSTEM**

THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12, OHIO

Yours for the asking—


T F TAYLOR FORGE
TAYLOR FORGE AND FORGED STEEL FLANGES
ON THIS SIDE – Data on the WeldELL line
ON THIS SIDE
– Data on Taylor Forged Steel Flanges

A VOLUME OF DATA

. . . covering welding fittings and forged steel flanges . . .

ON A SINGLE SHEET

Here is just about the handiest tool ever devised for the pipe designer. Data on welding fittings and flanges that otherwise could be found only by plowing through many catalog pages and tables have been ingeniously condensed on the two sides of the durable letter-size card illustrated above.

One side covers the broad WeldELL line of Taylor Forge welding fittings. For every nominal pipe size, ½" through 30", it shows the wall thickness for every weight of every fitting in every available material. It also shows all required dimensions of all types of fittings.

The other side covers the world's most complete line of forged steel flanges. For every nominal pipe size, ½" through 24", it gives all essential dimensional and bolting data for all types of flanges in all weights. A particularly useful table (see reproduction) is that showing welding neck flange bores which enables you to determine the I.D. of any nominal pipe size without separate calculation. Thus the sheet gives you O.D. and I.D. of any weight of pipe.

The card is varnished to make it stand the steady usage you are certain to give it. To obtain your copy see your Taylor Forge distributor or **MAIL THE COUPON.**

T F

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS

General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities.
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send me one of your fitting and flange sheets:

NAME _____

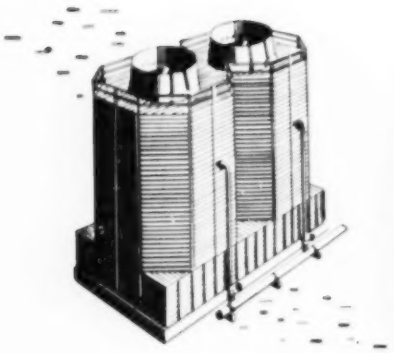
POSITION _____

COMPANY _____

STREET ADDRESS _____

CITY _____ ZONE _____ STATE _____

Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.



FLUOR COUNTERFLO COOLING TOWERS offer many unique features — all worth looking into!

When selecting cooling towers, it pays to look into the structural and mechanical design features of a Fluor Counterflo Cooling Tower. It is here that the difference between one cooling tower and another is evident—where the difference in structural stability, maintenance of mechanical equipment, and quality appearance lies.

The illustration at right—accurate in every detail—is the way your Fluor Counterflo Cooling Tower will look with a portion of the exterior wall removed. Note the exclusives, the extras, that make Fluor Cooling Towers a wise buy. When *dependable* performance, *low* maintenance, and *quality* appearance is essential or desirable in your plant or process operations, look into a Fluor Counterflo Cooling Tower.

Fluor Counterflo Induced-Draft Cooling Towers incorporate many important design features which cut the cost of maintenance and improve the appearance of cooling equipment installations.

STACK and FAN ASSEMBLY

8' high fan stack of 2" thick tongue-and-grooved redwood staves, rigidly ringed with steel angles and straps. Fan stack is supported on heavy, bolt-mounted metal ring—Drive shaft, couplings, right-angle reduction gear and stainless steel fan blades assure long life and low maintenance—Patented Vibration Cut-Out Switch guarantees safety.

DRIFT ELIMINATORS

Fluor Drift Eliminators are designed for minimum resistance to air flow induced through the tower. Two-pass, zig-zag pattern removes entrained water droplets from the air stream and controls drift loss to less than 0.2 of 1 per cent of water circulated.

DISTRIBUTING SYSTEM

Upspray chamber flushes an appreciable portion of heat load as water enters the tower. Patented, non-clogging, self-draining Spirodome nozzles insure water breakup under nominal pressure. Nozzle spacing controls uniform water distribution. Cell distributing systems are independent to assure maximum control efficiency of water being cooled.

DOUBLE-WALL SHEATHING

Panels of sheathing are prefabricated in uniform sizes to enable fast, easy installation. Inner wall is of 1" tongue-and-groove redwood—outer wall is of 3/8" battens spaced 1-1/16" apart—2" spacing between walls permits air circulation and prevents dry rot.

GRID DECKS

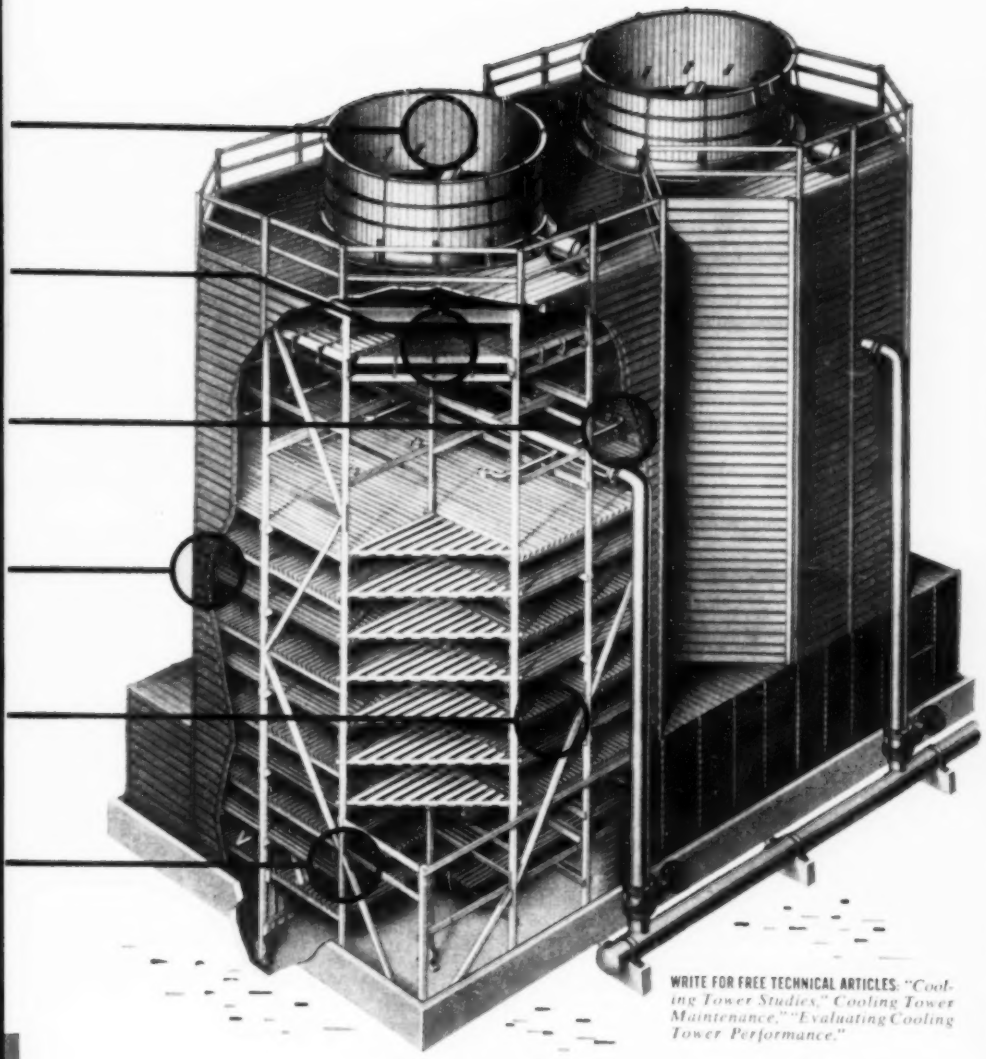
Rugged staging-bar grid decks are of rough-finished 1" thick select redwood—will withstand repeated washing and cleaning and are sufficiently strong to support a man's weight at the abuse of removing and replacing. Prefabrication and structural strength permit use of grid decks as scaffolding during erection.

TOWER STRUCTURE

Rugged 4" x 4" posts with 4" x 4" and 3" x 4" bracing—Corrosion-proof bolted internal gusset plate structural joints take both tension and compression for extra safety under all conditions. Posts are on 6' centers. Columns and bracing are designed with forethought to future tower extension—panels are reusable on new extension—bracing and columns need no modification.

BE SURE WITH **FLUOR**

(To obtain more data on advertised products see page 104)



WRITE FOR FREE TECHNICAL ARTICLES: *"Cooling Tower Studies," "Cooling Tower Maintenance," "Evaluating Cooling Tower Performance."*

THE FLUOR CORPORATION, LTD., 2500 South Atlantic Boulevard, Los Angeles 22, California

New York, Chicago, Boston, Pittsburgh, Tulsa, Houston, San Francisco, Birmingham, Calgary.

REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England

Simplest Flow Measurement

with the ALL-METAL Foxboro d/p Cell!

. . . gives fastest response, longest sustained accuracy, lowest installation cost

Simpler in design, simpler and much less expensive to install, far easier to maintain . . . the all metal Foxboro mercury less d/p Cell offers greater speed of response, permitting closer flow control, than has ever been possible before. Its negligible displacement and corrosion-proof construction of Type 316 Stainless Steel eliminate usual maintenance problems, even in service on highly corrosive or viscous fluids previously considered unmeasurable.

The Foxboro d/p Cell measures differential pressure by the force-balance principle and transmits pneumatically to indicating, recording, or controlling receivers. Small, compact, weighs as little as 14 lb. Ranges from 25" to 800" H_2O. Working pressure ratings up to 4000 psi. Steel or stainless steel construction. Inherent over-range protection. Easy in-the-field calibration and range changes. Optionally available with pre-assembled manifold piping shown in photo above.

Thousands of d/p Cells now in use throughout industry, with many repeat orders now on our books, indicate the wide acceptance and successful performance of this revolutionary development for the measurement of liquid, steam, gas, or air flow. Write for detailed Bulletin 420. The Foxboro Company, 2461 Neponset Avenue, Foxboro, Massachusetts, U. S. A.

- No seal pots
- No mercury
- No leveling
- Installed at the orifice

FOXBORO
REG. U. S. PAT. OFF.

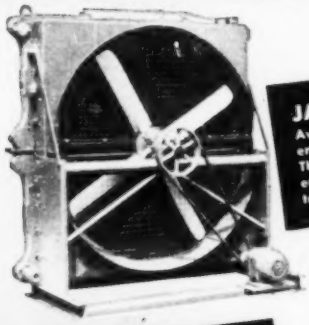
RECORDING · CONTROLLING · INDICATING INSTRUMENTS

FACTORIES IN THE UNITED STATES CANADA, AND ENGLAND

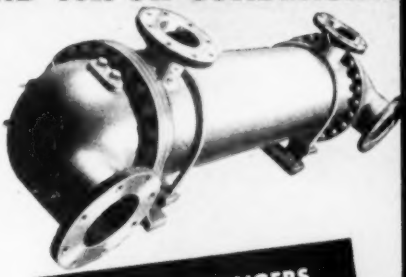
YOUNG OFFERS . . .

EFFICIENT HEAT TRANSFER

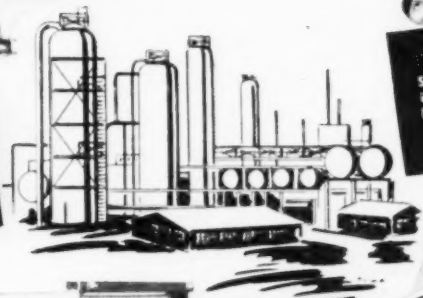
IN WATER, OIL, GAS COOLING-STEAM AND VAPOR CONDENSING



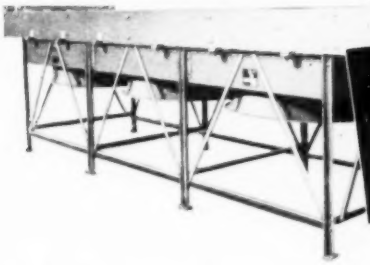
JACKET WATER COOLERS
Available in a wide range of sizes for engine jacket water or lube oil cooling. These units are sturdy, compact, and engineered to provide maximum heat transfer with low hp requirement.



"HC" COOLERS
Multiple unit installations provide economical handling of water, oil or gas cooling and steam and vapor condensing in any combination. Easily installed in the field.



HEAT EXCHANGERS
Space-saving units available from stock in fixed or removable tube bundle types. For jacket water or lube oil cooling in stationary or marine (fresh and salt water) applications.



"VAD" COOLING AND CONDENSING UNITS
Vertical air discharge units for extra large capacity cooling of water, oil and gas and condensing of steam and vapor in any combination. Low-level mounting means ease and economy in maintenance.

In addition to the field-tested products shown above, Young offers: gas, gasoline and Diesel engine cooling radiators; atmospheric and evaporative coolers and condensers; supercharger intercoolers, and similar products for the Petroleum Industry. Young supplements the design engineering of its equipment with application ingenuity thereby increasing the practicability of all Young products. For example, the popular "Vertiflow" Unit Heater, has been used successfully as an economical condenser. It can also cut heating costs by using the waste heat from engine jacket water for space heating. Young *engineered* applications cost no more. Contact your nearest Young Representative for further details.

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY

Dept. 262 A • RACINE, WISCONSIN
Factories at Racine, Wisconsin and Mattoon, Illinois

OIL FIELD DISTRIBUTORS
TULSA: J. R. Meek Company, 1341 S. Boston St., Rm. 109
LOS ANGELES: Flournoy & Everett, Inc., 5045 Santa Fe Ave.
MUSKEGON: Harold J. Young, 206 Montgomery Bldg.
Other Representatives in Principal Cities

COUPON BRINGS DETAILS ON YOUNG PRODUCTS

YOUNG RADIATOR COMPANY
Department 262A
Racine, Wisconsin

Please send information on the Young Products checked below, also name and address of your nearest representative.

☐ Heat Exchangers
☐ Jacket Water Cooling Radiators
☐ "HC" Cooling and Condensing Units
☐ "VAD" Cooling and Condensing Units

NAME

COMPANY

ADDRESS

CITY ZONE STATE

WIN, PLACE
AND SHOW

ANOTHER WAY OF SAYING UOP SERVICE IS COMPLETE

Across the board — that's UOP Service!

First . . . it provides all the advantages of a complete research, development, engineering and field service group without the expense of establishing and maintaining such a staff within the refiner's own organization.

Second . . . it provides supervision on new construction and operating experts to place processing units on stream.

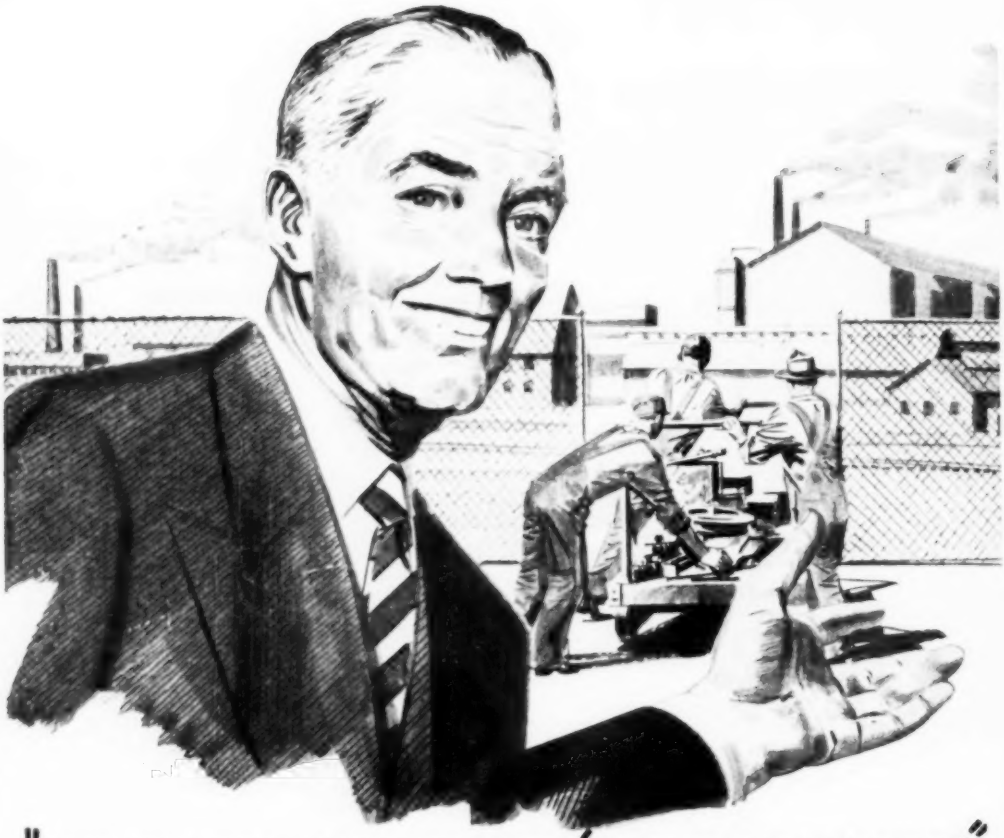
Third . . .it provides field men, whenever requested, to meet the exigencies of refinery operation and keep your day-to-day production at the peak of efficiency.

It's *the* Service that goes all the way to protect your refinery.

UNIVERSAL OIL PRODUCTS COMPANY

UOP General Offices: 310 S. MICHIGAN AVE., CHICAGO 4, ILLINOIS, U.S.A.
Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Refinery



"AND WE THOUGHT WE DIDN'T HAVE ANY SCRAP!"

"We don't make anything of steel . . . so we didn't think we were concerned in the national scrap program.

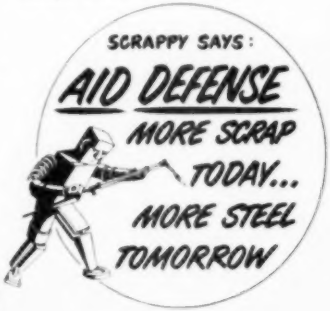
"Then we came to realize how badly *we* would be affected if steel products we *use* were shut off by the shortage of scrap.

"When we learned a *photographic film* manufacturer was able to collect 33 *carloads* of iron and steel scrap in his own plant—we began looking.

"We found plenty of idle metal that had rust on it and dust on it. Obsolete machinery. Outmoded equipment, jigs and fixtures. Broken parts—like wheels, chain, springs. Abandoned structures made of steel.

"We found plenty. And, knowing our best chance of *getting steel products* was by furnishing the raw materials for steel-making, we promptly called in our local scrap dealer.

"I'd urge *any* business to look over its premises with an eye out for scrap. Non-ferrous scrap is needed, too! Why don't *you* appoint one man—with authority—to act as *your* Scrap Salvage Director?"

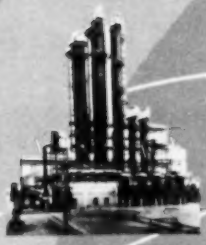


This advertisement is a contribution, in the national interest, by

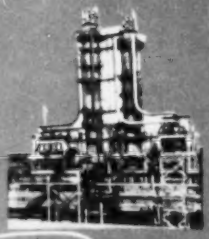
PETROLEUM PROCESSING

A PUBLIC SERVICE PROJECT THE ADVERTISING COUNCIL

(*To obtain more data on advertised products see page* 104)

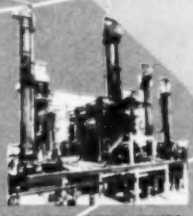


TOLUENE EXTRACTION



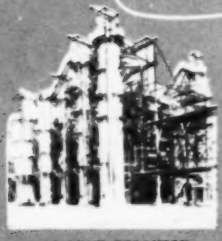
FEED PREPARATION

fractionation



IN ALKYLATION UNITS

SOLVENT NAPHTHA PRODUCTION



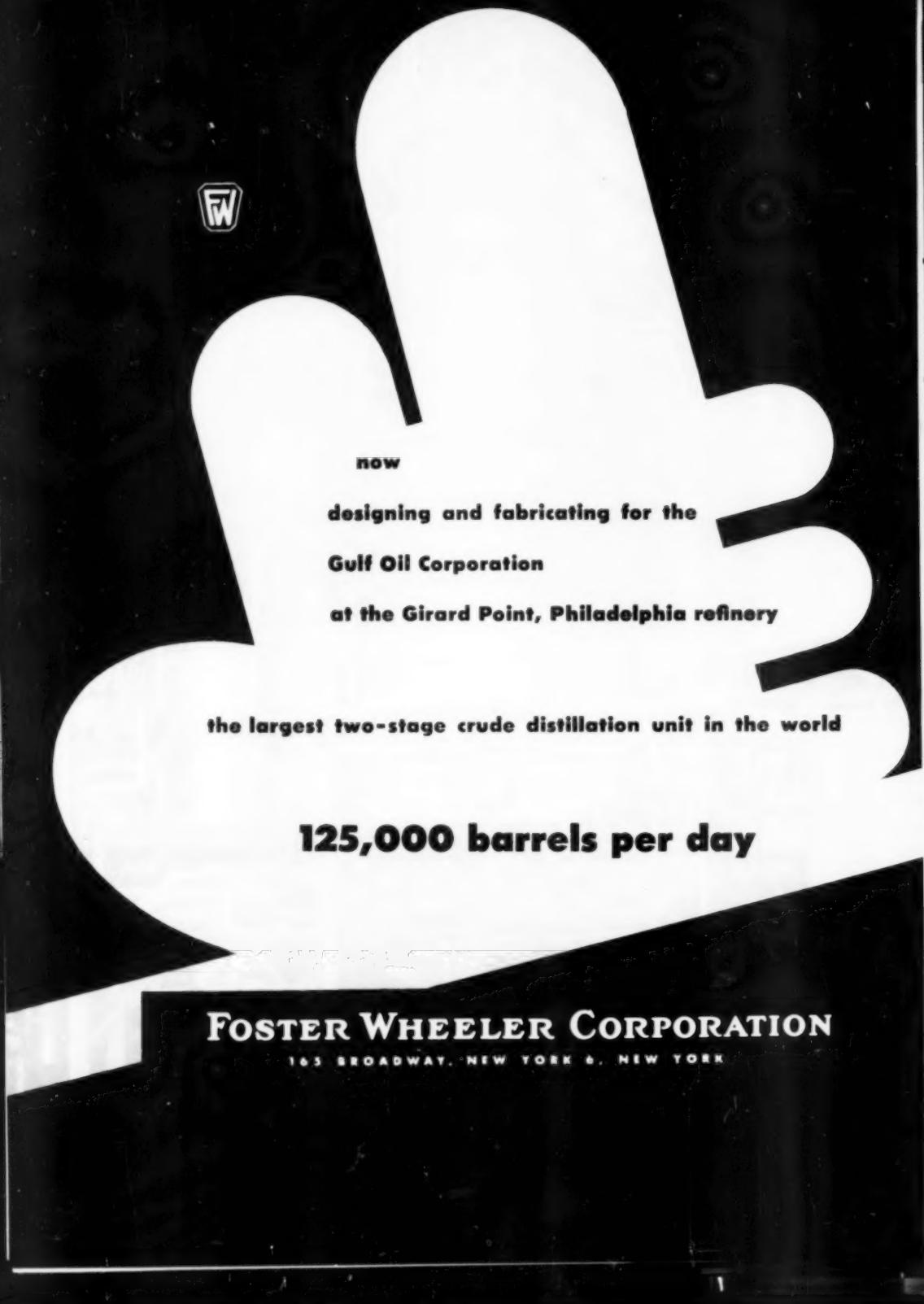
SOLVENT RECOVERY

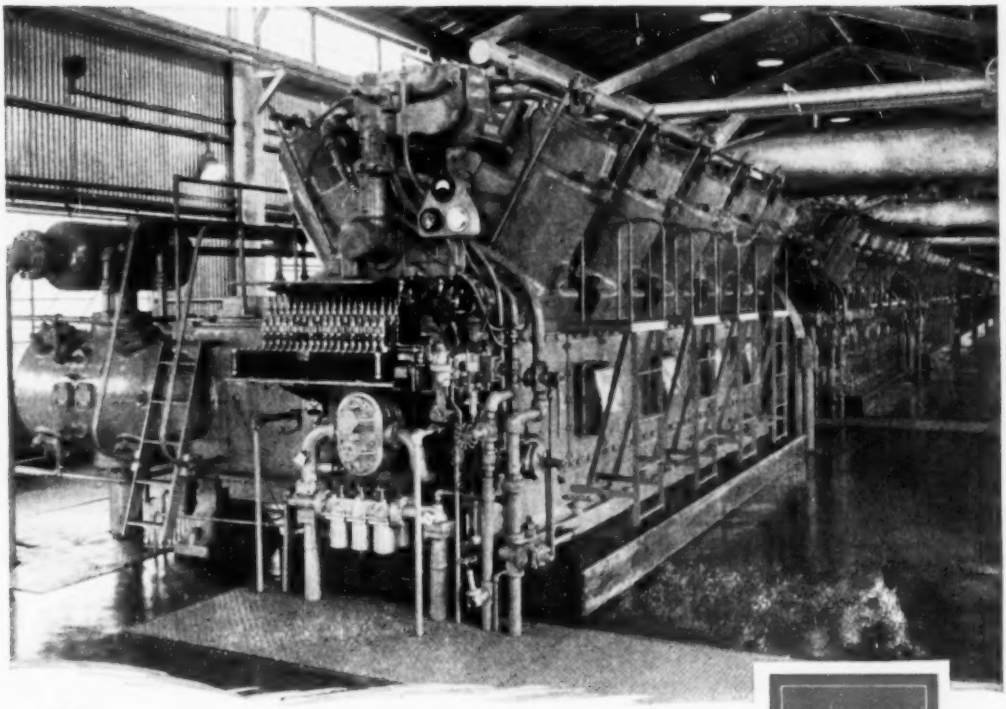
more than 2000 fractionating towers, representing many different processes, have been designed and constructed by Foster Wheeler in over 30 years' service to the worldwide petroleum industry.

FW

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, NEW YORK


now
designing and fabricating for the
Gulf Oil Corporation
at the Girard Point, Philadelphia refinery
the largest two-stage crude distillation unit in the world
125,000 barrels per day
FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, NEW YORK



Space savings add up big...

...in the Shell operated Elk City Plant!

Another Example of Efficient Power at Lower Cost

TAKE a look at the compact, clean-cut line of engine-driven compressors shown here — seven Cooper-Bessemer 10-cylinder GMV's. Not so long ago the rating of these units would have totaled 7,000 horsepower. But with today's *supercharged* GMV's, it adds up to 9,450 horsepower. Thus, 7 GMV's are now doing the work of 10 older-type units . . . *with no increase in speed* and in only 7-unit space. Think what this saves in installation cost, piping, housing, maintenance, supervision and other expense items!

What's more, supercharged GMV's, like these, also offer important new economies in fuel and lube oil consumption. Straight through it's a more *efficient* operation.

Here you have the reasons why Shell and so many other companies are taking advantage of the latest developments in Cooper-Bessemer V-Angle design. The emphasis is on *big savings*, combined with the smooth dependability long demonstrated by these modern V-Angle units.

The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

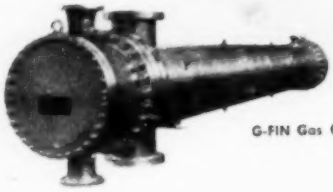
New York, N. Y. Washington, D. C. Bradford, Penna. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and
Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La.
St. Louis, Mo. Los Angeles, Calif. Chicago, Illinois Caracas, Venezuela

(To obtain more data on advertised products see page 104)

Why G-FIN is superior for all these heat transfer duties

G-FIN Condenser for vapors of viscous liquids

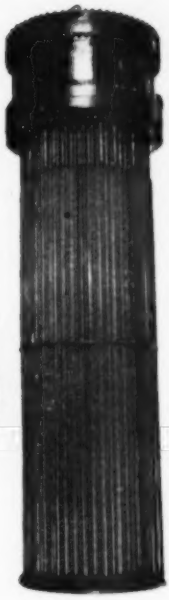
Twin G-FIN Section for heating or cooling fluids of low heat conductivity



G-FIN Gas Cooler

G-FIN Heat Exchanger for viscous liquids or gases of low heat conductivity

G-FIN tar-heated fluid Heater



G-FIN Contactor Bundle for removing heat of a reaction

If your processes involve transfer of heat between fluids of unequal heat conductivity — these are the types of services for which G-R G-FIN apparatus is far superior to conventional units with bare tubes.

The longitudinal fins on the outside of G-FIN elements have six to eight times the heat transfer surface on the inside of the elements. Therefore, when a fluid of higher heat conductivity flows inside the elements, these fins provide the additional surface needed by a fluid of lower conductivity flowing outside the elements.

That's why G-FIN units require fewer tubes than bare tube units in such services. Fewer tubes mean fewer tube joints, easier cleaning, and less maintenance expense, as well as higher fluid velocities with least pressure drop.

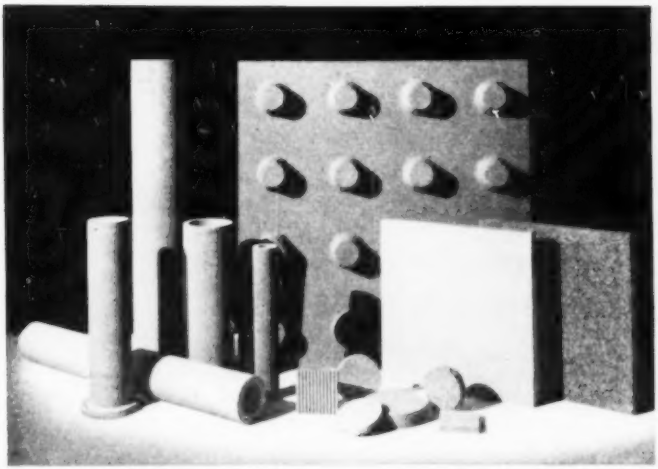
Each G-FIN unit also has special design and construction features not possessed by conventional exchangers. Write for bulletin describing suitable G-FIN apparatus for services in which you are interested.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR-231

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS



Gas-diffusing or filter mediums of Norton ALUNDUM* fused alumina are manufactured for a wide variety of commercial and laboratory operations.

Why should your porous mediums be uniformly porous?

Porosity may be defined as the percentage ratio of pore space by volume to the bulk volume of the piece. There are three types of pores: open, closed, and closed at one end. Obviously, the only passage *through* the medium is via the open pores. Therefore, if the flow of air or gas through the medium is to be uniform, it is essential that the medium's pores be uniformly distributed.

Norton, long experienced in the development of fused alumina products, meets this need with porous mediums of ALUNDUM material. Thanks to "controlled structure" processing, all Norton ALUNDUM porous mediums have substantially the same pore volume — while the size and number of open pores are varied to provide the desired permeability.

Other Advantages

ALUNDUM porous mediums are unaffected by acid, neutral or slightly alkaline conditions encountered in commercial and laboratory processes . . . they are exceedingly refractory, withstanding temperatures up to 1000° C . . . their unusual strength assures maximum resistance to abrasion, high operating pressures and breakage or chipping in handling.

Send For Bulletin

Bulletin No. 140 contains complete data as to physical structure, etc., of Norton ALUNDUM porous mediums, and other refractory products. Let it help you decide whether they will benefit your processing. Your Norton representative will be glad to supply you with a copy, or write direct, Norton Company, 597 New Bond St., Worcester 6, Mass.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

POROUS MEDIUMS

Canadian Representative
A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

Fused Alumina Catalyst Supports In Wide Choice Of Surface Areas

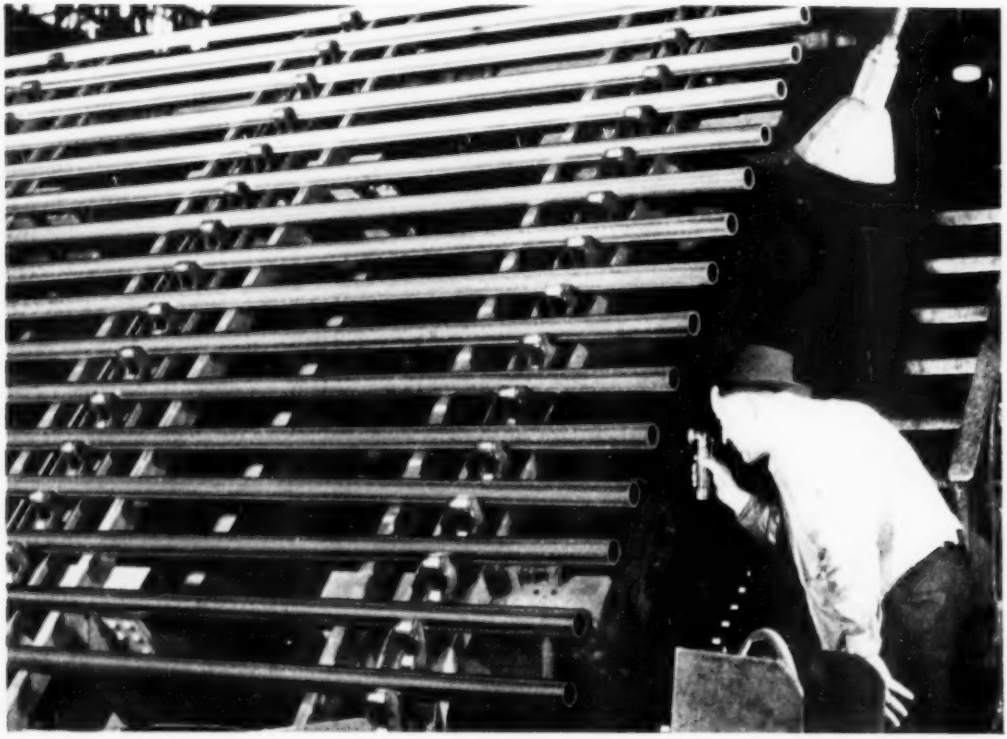
Norton Company is now making catalyst supports in commercial quantities, in five different mixtures of refractory grains, ranging from 77% to 89% fused alumina. Water absorption values of these catalyst supports vary from 14% to 22%, by weight, while surface areas by the nitrogen absorption method range from 0.025 to 0.824 square meters per gram. They are made in spheres, pellets and rings of varying sizes.

Get All The Facts

Your Norton representative will be glad to give you full information about these new catalyst supports. Or, a letter direct to us will get prompt attention.

NORTON COMPANY
597 NEW BOND STREET
WORCESTER 6, MASS.

*Trade Mark Reg. U. S. Pat. Off. and Foreign Countries



SPECIALIZATION **GIVES YOU UNIFORM HIGH QUALITY IN**

GLOBE ALLOY STEEL TUBES

When you specify GLOBE you get the finest, because Globe *specializes* in the production of steel tubes. For more than thirty years Globe *specialized* research, engineering and manufacturing facilities have assured customers of uniform high quality in alloy steel tubes for pressure or mechanical applications.

GLOBE STEEL TUBES CO., Milwaukee 46, Wis.

Chicago • Cleveland • Detroit • New York • Philadelphia
St. Louis • Denver • San Francisco • Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Globeweld welded stainless steel tubes — alloy — carbon — seamless steel tubes — Globecrome High purity forged mirror seamless tubes — Globe Welding Fittings.

TYPICAL ANALYSES:

Carbon Moly
1¼ Chrome ½ Moly • 1¾ Chrome ¾ Moly
2 Chrome ½ Moly • 2¼ Chrome 1 Moly
5 Chrome ½ Moly • 7 Chrome ½ Moly
9 Chrome 1 Moly
AISI 1335 • AISI 2317 • AISI 2512 •
AISI 4130, 4140 • AISI 4615 • AISI 8615, 8620, 8630, 8635, 8640 • 7% Ni. • 9% Ni.

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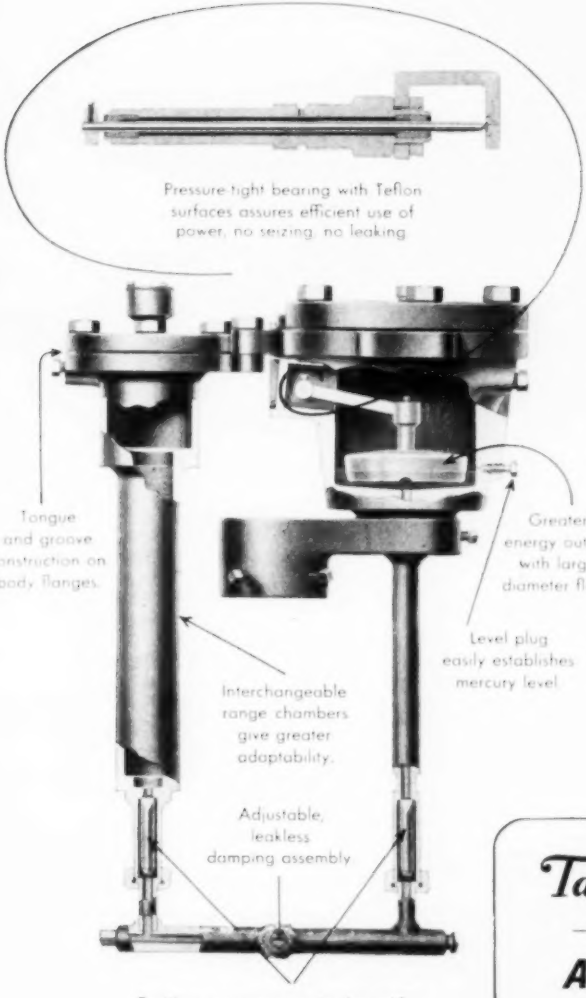
GLOBE SEAMLESS TUBES FOR MAXIMUM STRENGTH AND MINIMUM WEIGHT

Pierced from solid steel billets . . . with no seams or welds. Globe seamless tubes are available in many sizes and wall thicknesses for exacting applications.

Taylor Mercury Manometer

DOESN'T SEIZE. DOESN'T LEAK!


Pressure-tight bearing with Teflon surfaces assures efficient use of power, no seizing, no leaking
Tongue and groove construction on body flanges
Greater energy output with large diameter float
Level plug easily establishes mercury level
Interchangeable range chambers give greater adaptability.
Adjustable, leakless damping assembly
Positive overrange protection with mercury-submerged Nylon check valves.

HERE'S a mercury manometer that's ideal wherever you need something *better* than conventional flow, liquid level and other differential pressure measuring instruments. Check these features:

Greater accuracy results from greater power of extra-large float efficiency transmitted by mirror-finished shaft and Teflon bearing; also straight-line calibration.

Greater adaptability, thanks to six interchangeable range tubes (*10", 20", 50", 100", 200" and 400" of water*) which, except 10", may be over or under ranged 33⅓%.

Maintenance is easy, because the low pressure chamber cover permits easy access to float and lever arm during calibration, and the entire pressure tight bearing can be easily, economically replaced.

Performance is dependable, because the submerged check valves give positive shutoff, damping valve is adjustable under full pressure, and there's ample room in the mercury chambers to accommodate surges.

This is just one of many Taylor Instruments to measure, record and control practically any process variable with new high accuracy and dependability. *Write for Catalog 9375* or ask your Taylor Field Engineer how Taylor can help you cut cost, protect your product quality. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity

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MEAN
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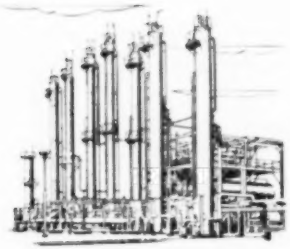
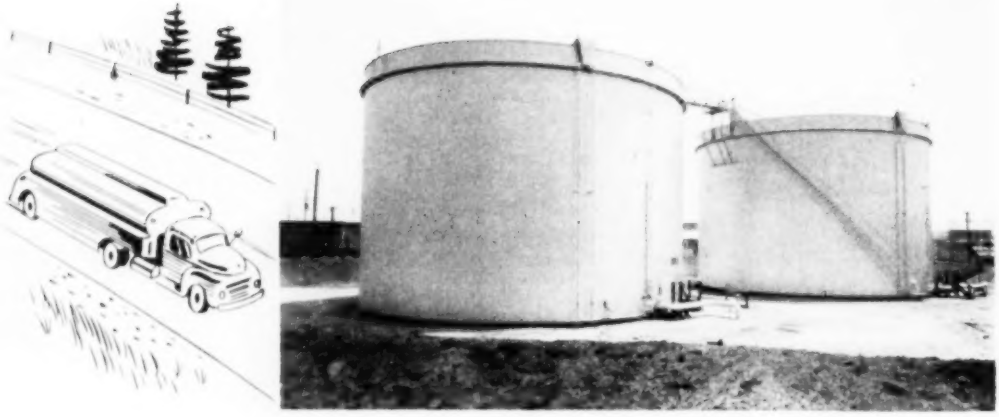
HORTON* TANKS

. . . Supplying Gasoline to the Los Angeles Area





THESE two 25,000-bbl. Horton tanks at Vernon, California are working for the General Petroleum Company. Gasoline is piped into them from the nearby Torrance refinery, stored briefly —and then supplied to a loading rack for distribution to the Los Angeles area. A huge gasoline demand in this highly motorized city requires these tanks to be filled and refilled many times. This means costly evaporation losses unless modern storage equipment is used.

That's why these two storage tanks are equipped with Horton Floating Roofs. By riding directly on the liquid in the tank, Horton Floating Roofs eliminate the space where air-vapor mixtures might form. Elimination of the vapor space means that there is no air-vapor mixture to be displaced by expansion or filling. Profits don't disappear into thin air. In addition, corrosive action is minimized by preventing air from coming in contact with the underside of the roof plates.

For more information about either Horton Double-Deck, Pontoon or Pan Floating Roofs for efficient working storage of crude oil and motor gasoline — Hortonspheres — Hortonspheroids — Hortondome Roofs — Hemispheroids — Horton Vaporspheres (flat bottom tanks, pressure vessels —refinery towers—or elevated water tanks—write to our nearest office. Our four strategically located plants always stand ready to serve the needs of the petroleum industry.

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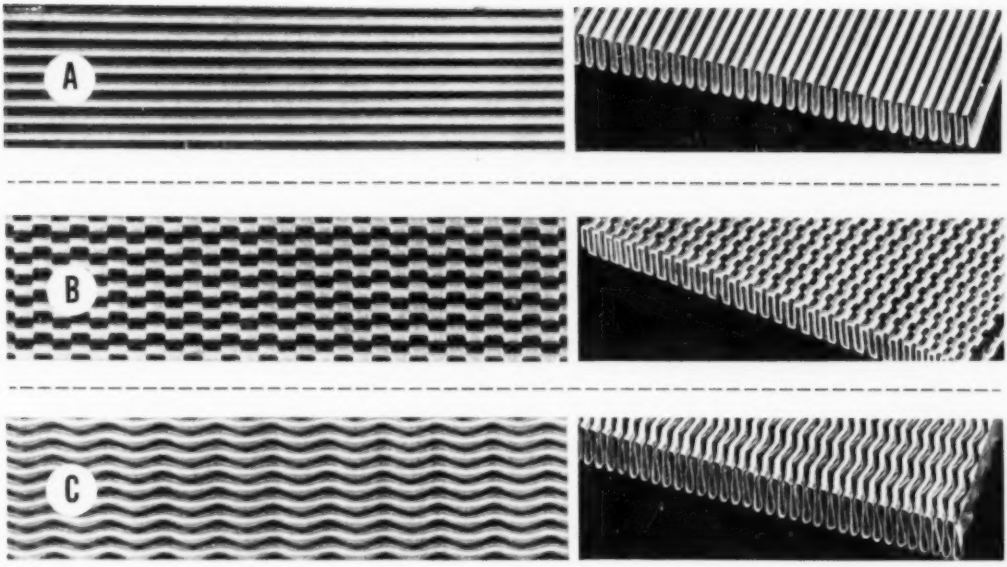


Three of the many types of fin section available.

TRANE Brazed Aluminum Heat Exchangers Offer Wide Choice of Heat Transfer Surfaces for Greater Design Flexibility

With Trane Brazed Aluminum Heat Exchangers, you choose from a great variety of surfaces in solving exactly your heat transfer problems. They may be straight and continuous (A). They may be serrated (B). Or they can be of herringbone design (C). With these basic designs, exactly the right surface can be selected to provide the correct ratio of heat transfer to pressure drop characteristics.

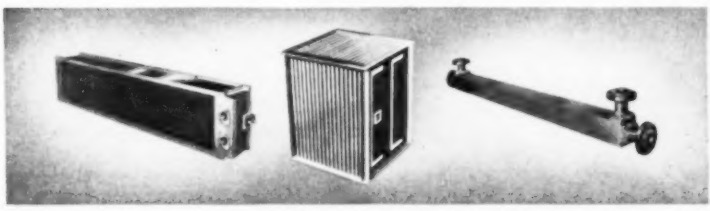
Many further variations of these general types are practical. The height and the thickness of the fin can be varied. So can the number of fins per inch. In fact, fins with entirely different patterns, heights and number of corrugations per inch can be used side-by-side to handle different fluids in the same exchanger.

Thanks to this great flexibility you can provide just the heat transfer, just the pressure drop volume, velocity number and direction of passes you want with Trane Brazed Aluminum Heat Exchangers.

Design flexibility is but one of the many advantages of Trane Brazed Aluminum Heat Exchangers. Compared to conventional exchangers, they produce more heat transfer efficiency in $\frac{1}{4}$ the space with $\frac{1}{3}$ the weight at approximately $\frac{1}{2}$ the cost.

These all-aluminum heat exchangers are rugged, too. They take test pressures up to 1,000 pounds per square inch and temperatures from −300° to 500° F.

Whether the job calls for high or low temperatures or pressures, one stream or many, Trane Brazed Aluminum Heat Exchangers can be the answer. Contact your Trane sales office or write direct.



Here are a few of the many varieties of Trane Brazed Aluminum Heat Exchangers which are now in actual service: 1) A cross flow unit for liquid-to-gas exchange used for condensing purposes. 2) A cross flow gas-to-gas unit which is used for intercooling for aircraft engines. 3) A counter flow liquid-to-liquid exchanger for high pressure application.

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MANUFACTURING ENGINEERS
OF HEATING, VENTILATING AND
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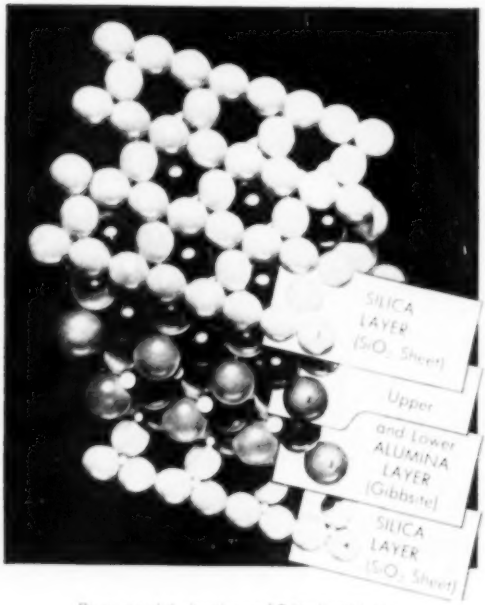

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NOT THE FRESH BUT THE EQUILIBRIUM CATALYST DOES THE CRACKING AND DETERMINES THE YIELDS AND DISTRIBUTION OF CRACKING PRODUCTS.

ACCUMULATED EXPERIENCE AND DATA SHOW THAT YEAR IN AND YEAR OUT THE STABLE CRYSTAL STRUCTURE AND SIZES OF FILTROL CATALYSTS GIVE UNIFORM DEPENDABLE EQUILIBRIUM CATALYSTS.

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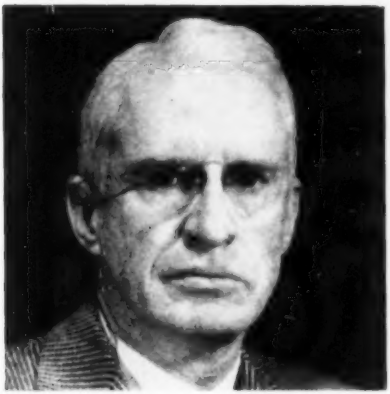
CATALYSTS AND ADSORBENTS

Synthetic Liquid Fuels - - - When and How?



EUGENE AYRES looks at the future

- Oil shale shows best immediate promise—commercial exploitation by 1965.
- But future depends upon coal—wide-scale utilization by 1980.
- Coal main source by 2000—but not via hydrogenation.
- Without radically new ideas, coal hydrogenation dead now and will remain dead.
- Main route likely to be modifications of Fischer-Tropsch.
- Needed most—a fully integrated energy industry, combining oil, coal, and electric power.
- Coal mining costs will drop—production will rise 500% through use of machines.
- Plausible sources for U.S. 1980 demand for 3.5 billion bbl. fuel—49% from coal tar, 28.5% from petroleum, 8.5% from shale oil, 14% from coal char.
- U.S. share of world oil production will drop—from present 50% to perhaps 10% by end of century.

By EUGENE AYRES

Gulf Research & Development Co.

THE production of liquid fuel from coal and oil shale is an inevitable part of the future industrial picture. Over the past few decades industry and government more and more have been getting down to "brass tacks". The general feeling of both has been that the proper time to make intensive technologic and economic studies is before the problem of liquid fuel supply becomes urgent, while petroleum is still abundant and proved reserves are rising year by year.

The adoption of such a timetable of research has made it possible to consider the projects dispassionately without the distortion of judgment that sometimes occurs when we feel that "time is running out." Any industrial project which requires capital expenditures of unprecedented magnitude, vast quantities of steel, drastic social readjustments, and many years of time for construction, must have the benefit of the best collective talents of the nation well in advance of the time the plan must be put in effect.

For this reason the fuel industries have spent many millions for research on synthetic fuel projects that could not be expected to become profitable commercial enterprises for many years to come. Some of the birthpains of industrialization are even now under way at Brownsville, Texas. The petroleum industry has given its wholehearted support to certain phases of research by the U. S. Bureau of Mines. Industry is not always in agreement with the Bureau. Far from it. From the crucible of disagreement the truth is being forged, but the task of analysis is formidable.

What is involved is not the application of new processes to an old industry but rather the putting together of many elements to construct, on paper, a wholly new industry. Some of the elements are so new that no commercial precedents have yet been established. This is particularly true of some of the processing steps. Elements that are old in principle, such as mining, must be severely modified to adapt to new conceptions of high magnitude and low cost. Complete new towns must be projected for sparsely settled regions of the West.

What we know now about the synthetic fuels business can be condensed into a few paragraphs.

1. Oil shale can be exploited today without operating "in the red". This does not mean operating without monetary loss because at present prices of motor fuel the enterprise would earn only a little more than nominal interest on a funded investment. To attract capital, in competition with other business ventures, the wholesale price of gasoline would have to average at least 8c gal. higher than present markets.

2. These remarks apply only to the portion of our oil shale reserves that are fairly high in oil and located in thick horizontal beds along the sides of deep canyons. The canyons are necessary as dumping areas for ash after oil has been

Synthetic Liquid Fuels

produced by "retorting". The ash will average higher than a ton per barrel of oil. Suitable oil shale beds are found in Colorado along Parachute Creek, Clear Creek and Cunn Creek all tributaries of the Colorado River. The shale beds there run about 150 thousand barrels of recoverable oil per acre. Some billions of barrels could probably be produced from these favorable locations. Additional billions could be produced from less accessible oil shale at higher costs.

5) We are consuming in the U. S. more than two billion barrels of petroleum per annum. To make a complete substitution from oil shale would require a mining industry about 30 times as large as the entire U. S. iron ore mining industry, would increase the population of Colorado by at least a million persons and would require the investment of about forty billion dollars. Speculation with regard to a project of this magnitude is idle because the volume of water available there for people and plants could not take care of more than a minor part of total U. S. consumption. The present prospect is for the production of about 7 billion barrels from oil shale spread over about two decades, and then a lower rate of production at somewhat higher costs.

6) Technology of mining oil shale has been excellently developed by the Bureau of Mines. The other technical steps are straightforward. Present estimates of costs are believed to be trustworthy, but no substantial reductions in costs are anticipated from future research.

7) Our oil shale reserves are only about 3% of our coal reserves. We must depend in the future upon coal, but coal hydrogenation could not be practiced today without unconscionable economic losses. To earn even a nominal interest (3.5%) on investment, the wholesale price of gasoline would have to rise 18¢ gal. To attract capital in competition with other business ventures, the price would have to be at least 4¢ higher.

8) These remarks apply to the best of our coal resources (bituminous). Much of our coal reserve is subbituminous and lignite for which costs might be even higher.

9) To make a complete substitution of U.S. petroleum consumption from coal would involve a tripling of our present coal mining industry, would occupy a million and a third employees, and would require the investment of a hundred billion dollars, nearly three times the gross value of the present petroleum industry.

10) Technology of coal hydrogenation is complex and clumsy. Careful studies of the process during recent years have convinced fuel technologists that the difficulties of coal hydrogenation are inherent, and that no substantial improvement can be expected from development work in the future. Without some radical new ideas the series of operations comprising coal hydrogenation is dead now and will remain dead. But *parts* of the coal hydrogenation process are certain to be applied.

Speculation

If coal were to be converted to liquid fuel without regard to other aspects of the energy problem, we would probably use modifications of the Fischer-Tropsch synthesis, which appears to be cheaper and more flexible than hydrogenation. But it is doubtful that any single process will be responsible for future supplies of liquid fuel. Most favorable economics should come from a highly integrated *energy industry* which would supply not only increasing amounts of liquid fuel but also even more rapidly increasing amounts of electric power. Chemical intermediates would be minor but important by-products—only a few per cent of coal input.

The present essential demand for liquid fuel would require about three times as much coal as the present demand for electric power, but the demand for electric power is advancing at a phenomenal rate, about three times as fast as demand for liquid fuel. Hydroelectric installations will be able to take care of only a small part of the future load. Our major dependence must be upon coal. A picture of the *energy industry* at the end of this century could be something like this:

Coal will be mined at low cost with ingenious machines. The rate of production will be at least five times what it is now. The coal will be crushed and, if necessary, partly cleaned. This crushed coal will be transported by pipeline to points where water supplies are adequate. (Promising commercial experiments are under way by Pittsburgh-Consolidation Coal Co. for pipeline transportation of coal.) Here the coal will be continuously distilled under conditions that will yield: (1) a maximum amount of tar, (2) some aromatic chemical intermediates, and (3) fine char.

A minor portion of the char, if necessary, could be converted to liquid fuel (and some aliphatic intermediates) by the Fischer-Tropsch synthesis. The bulk of the char will be transported by pipeline to suitable points for use under large boilers and for generation of electric power. The tar from the primary distillation of coal will be converted to conventional liquid fuels by the hydrogenation process. The system will be sufficiently flexible to balance electric power and liquid fuel production with respective demands.

This is not necessarily what *will* happen but it *could* happen. What actually will happen will be determined by the needs of consumers of energy, by the course of technologic developments, by the circumstances of our fuel reserves, and, of course, by comparative process economics. However, at this time it seems certain that the future will see the welding of three great technologies—coal, petroleum, and electric power.

Extrapolation

The timetable for synthetic fuel development depends largely upon the course of production of petroleum in the U.S. and the world. A popular and important occupation for petroleum economists is to attempt to apply reason instead of hope to estimates of petroleum availability.

The *general shape* of the world's future annual production curve for petroleum can be predicted with certainty. The curve has been rising rapidly and no indication has yet appeared of any less rapid rise in the near future. And yet we know that the time will come when the rise will slow down and the curve will begin to drop. This is inevitable since the total amount of producible oil is finite. It would be interesting to know how high production will be at the peak and when this peak will occur. Both of these things can be predicted within reasonable limits if estimates of ultimate producible reserves are assumed to be correct. Furthermore, it is possible to throw some light on the plausibility of estimates of ultimate producible reserves.

After production has reached its peak and the curve is bending downward, we know that production will not drop precipitously to zero. Instead, the drop, although fairly rapid at first, will slow down and the curve will extend far into the future. The reason for this is that as oil in the earth becomes less abundant, it will become more difficult to find and more expensive to produce.

Production curves of this sort are not only logical but have appeared already for nearly all U. S. oil fields found before 1940, nine states, and five countries.

If annual production is plotted against years, the area enclosed by the curve represents total ultimate production. For any given area, an infinite number of curves can be drawn, but most of these curves will have some obvious fault in the light of physical circumstances. Inspection will eliminate at once the implausible. For example, it is unrealistic to assume that the peak of production has already been reached. It is also unrealistic to assume that the curve will peak sharply. The reason for the latter is that world production will represent the resultant of many diverse factors such as: (1) status of exploration in all parts of the world, (2) status of production

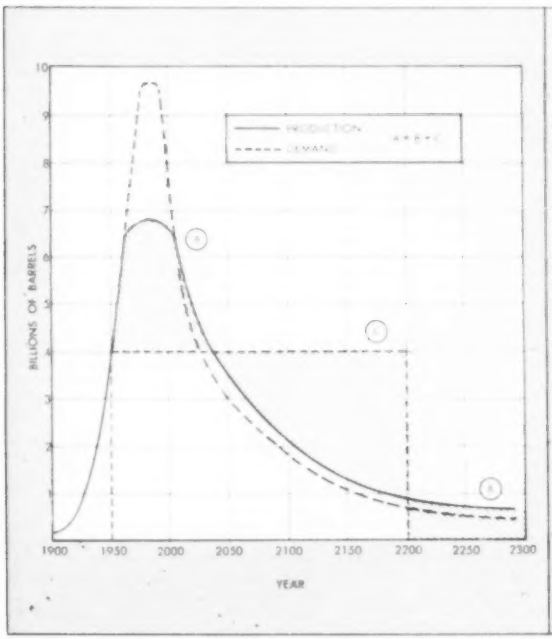


FIG. 1 World petroleum production curve, for 1,000,000,000,000 bbl. additional production

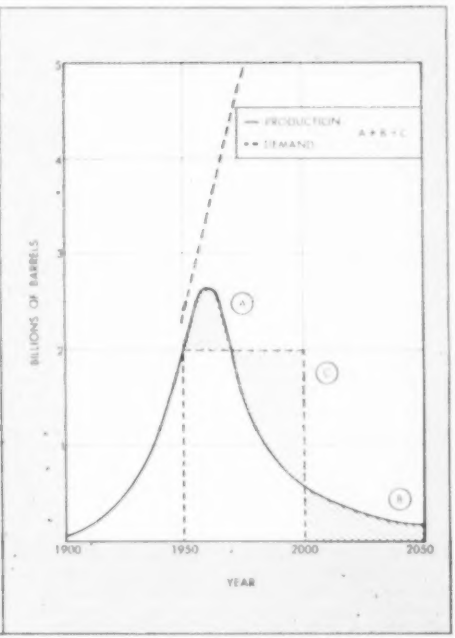


FIG. 2 United States petroleum production curve, for 100,000,000,000 bbl. additional production

technology, (3) political and economic relationships between producing and consuming nations to mention only a few. For some single oil fields the peaks can be relatively sharp, but for the sum of effects of many oil fields in many countries the peak can be expected to be blunt.

It is not easy to draw a curve of specific area with the general shape described above. For this reason it is useful to superimpose experimental curves on a rectangle of equivalent area. Then, by mere inspection, it is possible to detect substantial errors. The sum of the areas under the curve but outside the rectangle must be made equal to the area of the rectangle above the curve. For the world, one side of the rectangle as shown in Fig. 1 is the present annual world production of 4 billion barrels. The other side is 250 years, which gives a total of 1000 billion barrels. This is about the estimate made in 1950 by L. A. Weeks, Chief Research Geologist, Standard Oil Co. (N.J.). The estimate is more than ten times the "proved reserves" of the world.

It is difficult to draw a curve of plausible shape and specified area with apex beyond the year 1985. It seems fairly safe to say that *if ultimate producible reserves are in fact 1000 billion barrels*, the peak of world production is likely to come about 1985. It seems also fairly safe to say that production at the peak is not likely to be much higher than 7 billion barrels per annum, perhaps even lower.

In 1948, Weeks estimated world reserves at 600 billion barrels. An attempt to extrapolate a curve with area of 600 billion requires a peak of production within the next few years. This seems extremely improbable. It is fairly safe to say, therefore, that ultimate reserves are at least 1000 billion barrels. A 50% expansion of reserves would probably bring the peak to about the end of this century.

Various estimates have been made of world demand during the next few decades. According to one of the most generally accepted estimates, a production curve with apex in 1985 and with production then at 7 billion barrels per annum, would mean that a world shortage of petroleum may be encountered by 1970—a shortage that will become rapidly more substantial as demand rises in later years. This shortage will be in spite of the enormous quantity of petroleum still to be produced.

The same sort of extrapolation technique can be applied to U.S. production, as has been done in Fig. 2. If future producible domestic production is estimated at 100 billion barrels (more than three times our "proved reserves"), the date of the peak seems to be about 1960, and maximum production is under 3 billion barrels. Domestic production is now about 87% of demand. In 1975, it is likely to have dropped to 28% of demand. In 1950 U.S. production was about 50% of world production. By the end of the century we may be producing only 10%.

If dates of peak of production for the U.S. and the world prove to be much later than shown here, it will mean that ultimate producible reserves are much higher than they now are believed to be. The extrapolations seem to indicate that present estimates are not too high.

Why should it be reasonable to assume that predictions can be made of consequences that depend in so many ways upon economic, political, and military decisions of many men of many nations, and upon the certainly unpredictable course of technologic invention? All of modern physics is founded upon the conception of predictability of the sum of large numbers of unpredictable events. The larger the number of events, the greater the probability of prediction. In the case of oil production the number of events (mental and physical) are not large enough to make smooth statistical curves. For example, the actual production curve from 1900 to 1950 is jagged.

But the trend over that period is unmistakenly consistent in spite of world-shaking events such as two major wars, and many other political, economic and social changes. The last half of the century is likely to be even more eventful than the first. No isolated event can be foretold but the net effect of the combination should be relatively predictable.

We seem to have a choice between prediction of expansion for the indefinite future based upon hope, and prediction of the more probable shape of things to come, based upon reason. Experience will prove the latter adequate and therefore misleading, but hope would seem to be an even more slender reed to lean upon.

If such prediction can be accepted the consequences would be as follows:

1. Our rate of importation of petroleum is likely to rise moderately until 1960.

2. Importation should rise sharply between 1960 and 1970, but imports will begin to be impeded by world shortage.

3. By 1980 our imports should be vast, for we shall probably need more than 5 billion barrels per annum while producing only about one billion, but by then the world (including the U.S.) will probably need 40% more than it produces. International competition for oil will be acute and will become progressively more serious.

4. Maximum annual world production is not likely to be much higher than 7 billion barrels. This peak may come about 1985.

5. Maximum annual U.S. production is likely to be under 3 billion barrels, and this peak may come about 1960.

It must be remembered that the above predictions are based upon the assumption that additional oil to be produced in the future conforms to almost the highest estimates so far made by anyone. If the estimates are later increased by 50%, the peaks of production will be delayed only a few years.

Such study indicates that the exploitation of oil shale can be expected to mature by 1965. But since oil shale cannot supply (at reasonable cost) more than a small part of our annual demand, it will be essential to have utilization of coal well under way by 1970 and operating on a tremendous scale by 1980. By 1970 business and scientific planners should have prepared the groundwork of ideas and data for the right sort of commercial development. And in the meantime new technical possibilities will unfold from intensive research. For we shall have to combine commercial patience with an energetic attack on the ramparts of knowledge.

If extrapolated rates of petroleum production for the world and for the U.S. are even approximately correct, and if present trends of demand for liquid fuel and electric power can be counted on to persist for the next 20 years, we are forced to the conclusion that domestic supply can be maintained without the large-scale application to coal of either Fischer-Tropsch or hydrogenation. In other words, decreasing amounts of petroleum plus optimum probable amounts of liquid fuel from oil shale plus tar from low-temperature carbonization of the quantity of coal required for generation of electric power and for other normal coal uses will not be far below essential liquid fuel demands.

This assumes that the curve of petroleum demand (which is largely determined by the yield of motor fuel from petroleum) is sharply lowered by the production of motor fuel from petroleum residuum, the tarry material now used as heavy fuel oil. For, of course, the first step toward alleviation of liquid fuel shortage will be to convert to motor fuel all heavy oil not required for such essential uses as naval bunkers. This could reduce petroleum demand by at least a third. Plausible figures for 1980 would be: demand, 3.5 billion barrels, made up from coal tar (1.7 billion), petroleum (1 billion), shale oil (0.3 billion), and Fischer-Tropsch conversion of char (0.5 billion). If moderate importation were possible, conversion of char could be eliminated altogether.

These figures are based on average recovery of 0.5 barrel of motor fuel per ton of coal. Beyond 1980 the production of coal tar should rise more rapidly than production of petroleum will drop. This assumes a continued acceleration in rate of demand for electric power. The idea of such slight need in the future for the Fischer-Tropsch process is so strange that we hesitate to entertain it. But such a picture predicates a high degree of industrial integration: would mean that nearly all our coal would pass through the carbonization process; that very little coal would be burned in crude form.

It is possible now to see a future domestic energy industry in which the over-all thermal efficiency of conversion of coal to motor fuel may not be below 75%. In the coal hydrogenation process more than half the coal is used in the process to provide heat. This heat is not now recoverable but is consumed in the evaporation of precious water. So less than half the thermal value of coal going into the plant appears in the fuels coming out. Fischer-Tropsch is a little better but not much. With the higher thermal efficiencies of low-temperature carbonization and hydrogenation of tar, we shall not have to suffer the technological embarrassment of dedicating a billion tons a year of our coal reserves to the humidification of the atmosphere.

One problem for the future is sociological. Americans are adventurers. Thousands of men have been attracted to frontier oil towns because of the interest and excitement of discovery of oil and the taming of it. The rugged men of the oil fields know little of planned routine. Each day is a new adventure.

The operations of mining and carbonization will have almost none of this appeal. "Discoveries" will be matters of ancient record. Oil will not flow with unpredictable volume and violence. Boom towns will not spring up in unexpected places. Money will not flow with abnormal irregularity. There will be no prospect of "rags or riches".

Instead, everything will be blueprinted with scrupulous care. Stable communities will be developed in advance. Rigid economy will rule because the margin of profit, though predictable, will be slight. People will be attracted not by the prospect of adventure but by the promise of security and adequate pay for industrial employment. Men will be judged not by capacity for vigorous initiative, but for faithfulness to daily routine.

But this is looking far ahead. For during the next few decades business planning in energy production will be an unprecedented adventure involving new kinds of corporate integration at the very frontier of technical endeavor.

Meet the Author

Eugene Ayres, technical assistant to the executive vice president of Gulf Research & Development Co., is considered one of the world's outstanding authorities on energy resources. He is a member of the special sub-committee on synthetic liquid fuels costs of the National Petroleum Council.

Mr. Ayres received a B.A. from Swarthmore College in 1912 and, in the ten years that followed, occupied himself with the development of new industrial enterprises. He established the first American manufacture of diphenylamine, wool grease, lanolin, amorphous petroleum wax, and synthetic alcohols from petroleum. He developed and used methods of large-scale direct chlorination of petroleum hydrocarbons, of chemical dehydration of crude petroleum emulsions, of refining vegetable oils, and of continuous esterification of mixed alcohols.

Coal Carbonization May Open Door To Commercial Synthetic Fuels

NEW YORK BUREAU

A SOUND approach to the commercial production of synthetic liquid fuels may be by means of the low-temperature coal carbonization method developed by the Pittsburgh Consolidation Coal Co., of Pittsburgh, some oil company technologists here believe.

The unique feature of this development is that it provides a means for supplying both solid and liquid fuels from one plant to markets, in varying ratio to their relative demand. Some oil men think that, through this or some generally similar methods, synthetic fuels may start to supplement petroleum within 10 or 15 years, produced in plants entirely privately financed and operated.

The method of Pitt-Con consists of using the fluidized solids technique now applied in catalytic cracking of petroleum, to move powdered coal through a partial conversion stage. There is obtained a fine char residue containing about 70% of the original Btu value of the coal, 30 to 40 gallons per ton of tar liquid which could be converted to fuels, chemicals and other products in demand, and about 1000 cu. ft. of high content Btu gas.

Large Pilot Plant Planned

To further its work on the low temperature carbonization process, Pitt-Con will build a large pilot plant at its Library, Pa., research center. Construction contract has been let to the Chemical Plants Division of Blaw-Knox Co. and completion is scheduled for the latter part of 1952.

Operation of this pilot plant will provide answers to two major questions concerning the process, the company states: (1) cost and design data for a commercial plant, and (2) the production of sufficient quantities of liquids to permit commercial evaluation of the many chemicals and special carbons obtained. The tar liquid produced by the partial conversion of coal, when refined by processes developed by the company, it is stated, "yields low-boiling tar acids, creosotes or feed stock for making carbon black, and electrode carbons. The tar acids (phenols, cresols and cresylic acids) are used as chemicals and as intermediates by the plastics industry."

The carbonization process has been proved, according to the company, by more than 200,000 research man-hours and many months of operations of a smaller pilot plant.

It is contemplated that any commercial processing plants would be located in industrial areas in the East where large deposits of high volatile coal are to be found. Such locations it is assumed would provide a ready market for the fine char produced in the carbonization step, which is said to be of about the same quality as powdered coal. The gas also would be marketed locally. The tar liquid is said to be refinable into liquid fuels by mild hydrogenation processes of the type with which petroleum refiners are familiar.

Ties in With Coal Pipeline

The idea of moving the coal to industrial communities for processing, in place of doing this at or near the mine, is buttressed by the company's studies of moving coal by hydraulic transport in pipelines, at far less cost than rail movement. Joseph Pursglove, Jr., vice president, Research and Development of the company, states it has been proven feasible to move crushed or powdered coal in pipelines with water to about 50% of the volume of the coal. The company is now operating an experimental coal pipeline in Ohio. Water transportation could also be used to move coal to processing sites.

The coal company's low temperature carbonization process is considered to be flexible enough that economics of even the individual location could govern the type of operation. Industrial demand and supply for the coal char would be balanced against that for liquid fuels.

The first plants to be built, it is said, might be primarily to make char, chemicals in demand from the tar and premium grades of ash-free carbon. A later step, as demands for synthetic fuels to supplement petroleum made themselves felt, would be to convert the tar liquid into gasoline and other liquid fuels. If the liquid demand became sufficiently great, the char produced in the carbonization step could be gasified and the resulting gas treated by the Fischer-Tropsch process to produce synthetic gasoline.

Costs Less than Synthesis

The capital costs of the plant facilities for partial coal conversion are said to be only about 10% of the cost of a coal hydrogenation plant and 15% of a Fischer-Tropsch plant; thus making it practicable for them to be built and operated entirely by private capital, the coal company states.

The development of this process represents the second step by this company in the conversion of coal into liquid fuels and other products. Starting in the early 40's under an arrangement with Standard Oil Development Co., co-operative work was carried on in the complete gasification of coal, using the fluidized solids technique, and the conversion of the gas by the Fischer-Tropsch process into liquid fuels. This method proved to be possible, but too costly to provide competition for petroleum fuels. Pitt-Con then directed its experimental work toward the partial conversion method.

The process of coal carbonization at low temperature is promising, Frank Howard, New York consulting engineer, and formerly president of Standard Oil Development Co., stated in a recent address before the Drexel Institute of Technology. He said:

Also Sees Promise in Flexibility

"By distilling coal at moderate temperatures, there can be recovered a good grade of gas and about 30 gallons per ton of liquid tar, leaving behind a semi-coke which can be burned like coal but without producing smoke. The advantage of this method of utilizing coal to supplement the supplies of petroleum is the great flexibility of the operation.

"Efficient coal carbonization plants can be built in reasonable size and only as needed, first at locations near large consumers for the solid fuel produced, such as the great electric power stations with which the country is now studded.

"The gas produced can usually find a profitable outlet in these locations. The tar, 30 gallons per ton, can be divided into lighter fractions now quite valuable as chemical raw materials and heavier fractions useful mainly for liquid fuel. The fuel fractions would immediately supplement petroleum fuel oil and, when local prices justified it, they could be hydrogenated at the nearest oil refineries to provide refined products.

"If the need arises, the next step would be to convert the semi-coke into gas and then to gasoline by the Fischer-Tropsch synthesis. There is a beautiful possibility of flexible development in that art that does not exist in any of the other arts of producing supplementary liquid fuel supplies".

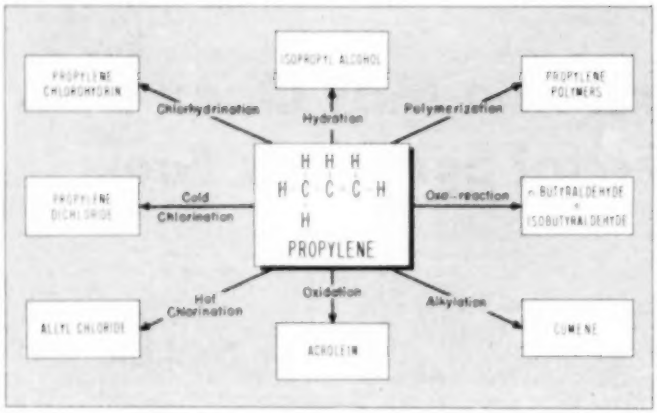


FIG. 1—**PROPYLENE TREE**, showing primary products produced from this petrochemical raw material

Propylene Petrochemicals

3 billion pounds were produced last year

By V. C. IRVINE
Shell Chemical Co., New York, N.Y.

TO orient ourselves with respect to propylene petrochemicals, it should be recalled that the bulk of all petrochemicals are made from a few basic raw materials. Propylene is one of these. In all, some 16 billion pounds of petrochemicals were made during 1950. Of these, some 3 billion pounds were made from propylene.

The commercially most important primary propylene derivatives are shown in Fig. 1, together with three processes which yield primary products of considerable future promise—acrolein, cumene and the butyraldehydes. I would like to emphasize that each of the products shown in Fig. 1 is a primary product from each of which stems series of additional products. For example, propylene chlorohydrin is used to make propylene oxide, which is reacted with itself and other chemicals to produce propylene glycol, glycol ethers and polyglycols. Propylene glycol is currently produced at a rate of about 100 million pounds per year; the product finds a wide variety of use in such applications as hydraulic fluids, printing inks, and cutting oils; it is used as a fumigant against streptococci, as a resin modifier, and it is one of the very few glycols suitable as an intermediate in food processing.

From Fig. 1 it is immediately obvious that propylene is an extremely versatile material and that discussion of all the major products derived from it would become rather lengthy. I would, however, like to discuss in some detail two major branches of the propylene tree to illustrate the number of different products derived from this one raw material and the wide diversification of their end-uses.

Isopropyl Alcohol Products

Commercially, and from the point of view of age, the hydration branch of the propylene tree is the most important. Fig. 2 shows the major products derived from isopropyl alcohol.

Total U. S. production of isopropyl alcohol in 1950 amounted to over ¾ billion pounds, all of it produced by hydration of propylene. Isopropyl alcohol itself has a number of important uses, such as its application in anti-freeze, as solvent and as rubbing alcohol, but its major importance derives from its conversion into acetone by dehydrogenation, which in turn can be converted into other products by condensation, hydrogenation and dehydration. The current annual acetone production of some ½ billion pounds stems about 95% from isopropyl alcohol, the remainder coming from fermentation processes.

The recent history of acetone illustrates in a clear way two of the four basic characteristics of the petrochemical industry, namely, ample supply and price stability. Before World War I, all acetone produced came from wood distillation. Prices fluctuated widely, and the supply was scarcely dependable. During the first World War, Weizmann developed his classic bacterial fermentation process to produce acetone and butyl alcohol as co-products starting from agricul-

A Copy for Your Files

Two of the most important petrochemical raw materials—ethylene and propylene—were discussed in detail in two papers presented at the annual meeting of the National Petroleum Assn. in Atlantic City last September. Between them, these two hydrocarbons account for about a third of the total 16 billion pounds of petrochemicals produced in 1950.

"Ethylene Petrochemicals," by Messrs. Kuhn and Hutchinson of The Texas Co., was published in two installments in the October and November issues of PETROLEUM PROCESSING. Reprints of the complete paper are available from:

Dr. Wayne E. Kuhn, Manager
Technical and Research Div.
The Texas Co.
135 East 42nd St.
New York 17, N. Y.

"Propylene Petrochemicals," by Mr. Irvine of Shell Chemical Co., is the current publication and rounds out the picture. Copies of the paper are available, as long as the supply lasts, from:

Miss Margaret A. Miller
National Petroleum Assn.
Munsey Building
Washington 4, D. C.

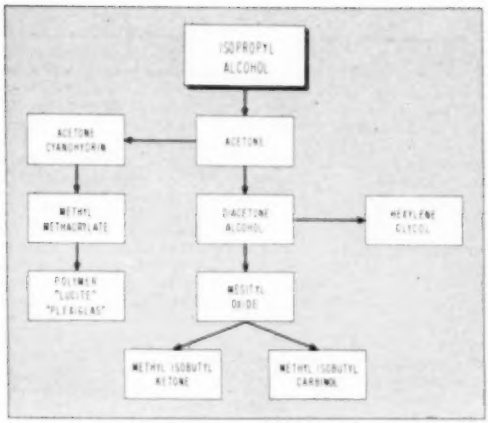


FIG. 2—ISOPROPYL ALCOHOL BRANCH, following the propylene hydration route

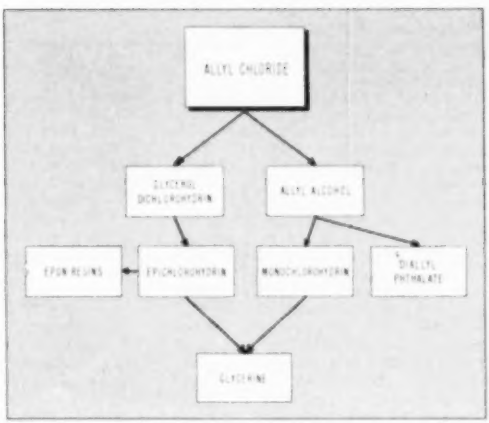


FIG. 3—ALLYL CHLORIDE BRANCH, following the hot chlorination of propylene route

tural products. This new process forced wood distillation practically out of the picture, but price fluctuations remained. During the '20's, prices varied between 12c and 25c lb. Shortly after 1930, petroleum-derived acetone gradually replaced acetone from other sources. The acetone price dropped to 10c lb. in 1932, and to 8c lb. in 1936. During most of the 1940's, the price was around 7c lb. Currently, the price is around 8c lb. During the last 15 years the average price of acetone has not varied by more than a penny or two, due to the stabilizing influence of propylene as a source of supply, while at the same time the demand increased many fold.

Acetone itself finds application as a solvent (e. g. in the manufacture of Cellulose acetate rayon) and as an extractant (for antibiotics such as penicillin), but its major use is as a chemical raw material in the production of plastics, solvents and other products.

Diacetone alcohol, mesityl oxide, methyl isobutyl ketone and methyl isobutyl carbinol find their primary use as solvents in the surface coating industry. The requirements of this industry are many and varied. They depend upon what kind of a surface is to be covered and the conditions under which the finish is applied. Consequently, the surface coating industry has developed many different paint and varnish formulations requiring a whole array of products. Although in the final finish the solvents used during the surface coating operation are no longer present, the types of solvents used have a very profound effect on the appearance and the general properties of the final finish. It took the petrochemical industry, as well as the surface coating industry, a substantial amount of time and effort to develop fully satisfactory formulae covering use of the petrochemical solvents.

Hexylene glycol, another product derived from acetone, has found an important and still increasing market in the fields of brake fluids, cutting oils, and leather and textile treating agents. All these fields are highly specialized and a substantial amount of product development and technical service work was, and is, necessary.

These products illustrate one aspect of the petrochemical business which deserves comment. Petrochemicals are in general sold to other industries, and it is almost always necessary to carry out a substantial amount of work on the end-uses of a new petrochemical to satisfactorily introduce the product. Data are required to convince the industrial customer that the new product is a good one and offers advantages. In addition, further work is often necessary to fit a new product into existing plants and processes.

Another important product derived from acetone is methyl methacrylate. This product, after polymerization, is sold under the trade names "Plexiglass" and "Lucite". It is used in various molding operations producing a large variety of crystal-clear articles of different size, shape and color. Many of the uses of these molded articles are well known, such as the domes in military aircraft, window display fixtures and toilet articles.

These products represent only the major products derived from isopropyl alcohol which, you will recall, was only one of the major branches of the propylene tree.

Allyl Chloride Products

Another major branch is that which stems from hot chlorination of propylene and yields allyl chloride as a primary product. Fig. 3 shows why allyl chloride has become an important intermediate for the production of petrochemicals; it is the raw material needed for the production of synthetic glycerine.

The development of a commercial process for the production of glycerine from propylene is one of the major recent achievements of the petrochemical industry. This important chem-

Meet the Author

V. C. Irvine joined the staff of Shell Development Co. at their Emeryville, Calif., Laboratories in 1934. From then to 1943 he was engaged in research on colloidal and physical chemical problems and on development of catalysts for both oil and chemical processes. Interest in the chemical industry led to his transfer in 1943 to the Market Development Dept. of Shell Development Co. In 1945 he moved to Shell Chemical Corp., where he became manager of the Sales Development Dept. in 1946.

This year Mr. Irvine was promoted to the position of manager of the newly-formed Product Development Dept. In his current position he is responsible for introduction of new products and administration of Shell Chemical's Technical Service Laboratory at Union, N. J.

Mr. Irvine obtained a B.S. in Chemistry from the U. of California in 1934, and attended the Advanced Management Program of the Harvard Graduate School of Business Administration in 1948.

ical is vital to our national economy. It is used in such products as alkyd resins, cosmetics, cellophane, tobacco, dynamite, pharmaceuticals, tooth paste and even in candy. Glycerine has been traditionally obtained as a by-product of the manufacture of soap from fats and oils. Ever increasing demands for glycerine on the one hand and the impact of synthetic detergents on production of soap on the other hand made development of an independent method of producing glycerine highly desirable. The allyl chloride route provides this method and, in keeping with its traditions, the petrochemical industry has provided the chemical industry with an adequate supply of glycerine of purity surpassing any heretofore commercially available.

Glycerine, however, is not the only important chemical produced from allyl chloride. As shown in Fig. 1, two different raw materials for the production of a large variety of high molecular weight compounds have become available on a commercial scale after the war years. These products are allyl alcohol and epichlorohydrin.

Allyl alcohol derives part of its importance from its commercial conversion into esters. These esters have found use as components of synthetic resin formulations.

Commercial availability of epichlorohydrin has led to production of an entirely new series of resins. These resins owing to their unusual combination of adhesion, flexibility and chemical resistance are finding applications in a wide variety of fields. baking finishes, primers, floor varnishes and can coatings are among their surface coating applications.

An entirely different type of product for which allyl chloride is an important alternate raw material is allethrin. This product has been found to be an excellent substitute for natural pyrethrins for many uses. In certain uses allethrin even excels in performance. The demand for pyrethrins is continuously increasing, owing to its extensive use in the manufacture of household insect sprays, gram and mill sprays, and aerosol insecticides. The only source of pyrethrum so far has been the flower of the pyrethrum plant, the latter is grown mainly in Kenya, with smaller quantities produced in the Belgian Congo and Japan. Because of a variety of reason, a sharp increase in the annual production of pyrethrum flowers seems not quite possible. Again a petrochemical opens the way to satisfy the needs of industry, agriculture and the household.

Other Products

Returning to Fig. 1, we have yet to discuss polymerization, alkylation, the oxo-reaction, and controlled oxidation. Space permits only a few comments to highlight these branches.

Extensive utilization of certain fractions of propylene polymers for the production of petrochemicals is a post-war development, although the use of the total polymer fraction as component of gasoline was well established during the war years. These fractions are used to manufacture dodecyl benzene and alkyl phenols, while polymers of propylene are also used for the production of isooctyl alcohol.

Of these three products, dodecyl benzene is produced in by far the largest volume, and its level of production is reported to be in excess of 150 million pounds per year at the present time. This product, after sulfonation, yields the most widely used active ingredient of synthetic detergents. The latter products in the post-war years have already captured about 60% of the total soap market. This phenomenal growth demonstrates how fast the petrochemical industry can increase production of new compounds if the market is favorable.

In this particular case, however, a snag developed. The benzene required for alkylation with propylene tetramer was a by-product of the coke producing industry. The demand for benzene for the production of dodecyl benzene and other chemicals exceeded availability. Consequently, output of dodecyl benzene was limited by benzene availability, as was the output of other important benzene derivatives such as styrene and phenol. The remedy devised by the petrochemical industry was typical; it started making benzene from petroleum.

Some co-products bring another [illegible] well known product, namely phenol, within the boundaries of the petrochemical industry. The established routes for the production of this compound involve chlorination or sulfonation of benzene. Both sulfuric acid and chlorine are in short supply, and it is important that a new process has been developed for the production of phenol which does not require large quantities of either of these two basic chemicals. This process uses as raw material cumene, an alkylation product of benzene and propylene, well known because of its use during World War II as an aviation gasoline component. Cumene, after oxidation with air and decomposition of the intermediate, yields phenol with acetone as a co-product. From announcements made in the press recently, it appears that application of this process on a commercial scale is likely in the near future.

(On Oct. 31, Standard Oil Co. of California announced that it was going to build the "first synthetic phenol plant in the west" at its Richmond refinery, at a cost of approximately $1,000,000. The plant will utilize a "recently-developed synthetis process in which neither sulfuric acid nor chlorine is used" apparently the process referred to above. Editor)

Returning again to Fig. 1, two branches are left. Correctly speaking, considering the size of the other branches, these might be characterized as "sprouts." Both are new and both show real promise of future growth. From acrolein, which can be prepared by controlled oxidation of propylene, literally hundreds of new compounds which formerly could only be prepared with difficulty can now be made easily. Already methionine, an essential amino acid, is being produced commercially from acrolein, and other commercial products will undoubtedly follow.

The oxo-reaction applied to propylene gives two basic building blocks, normal and isobutyraldehyde, and offers a new route from propylene to well-established groups of organic chemicals including isobutyl and normal butyl alcohols, butyric and isobutyric acids, cellulose acetate butyrate, and 2-ethyl hexanol.

It should be pointed out in conclusion that these developments from propylene and, in fact, all major developments in the petrochemical field have required major efforts, even in petroleum industry terms, involving large research expenditures, solution of difficult engineering problems, and investment of sizable capital. Competition has been keen, not only between petrochemical companies, but with established firms producing competitive products from other raw materials.

Young but Big

The petrochemical industry is a young industry, not yet 30 years old. Although young, it is a big industry. It is perhaps the fastest growing part of the chemical industry, which has repeatedly been called phenomenal in recent years.

These are broad, overall characteristics and stem from certain basic or underlying characteristics. Of these, four are of particular significance:

"1. An adequate and expandable ability to produce a given product to meet growing demands.

"2. Dependable and high quality of all products.

"3. Relatively stable prices, and

"4. A steady stream of new products.

"These basic characteristics are not foreign to this audience, and it is obvious that the petrochemical industry is indebted to the petroleum industry for far more than the 'petro' part of its name."

V. C. Irvine

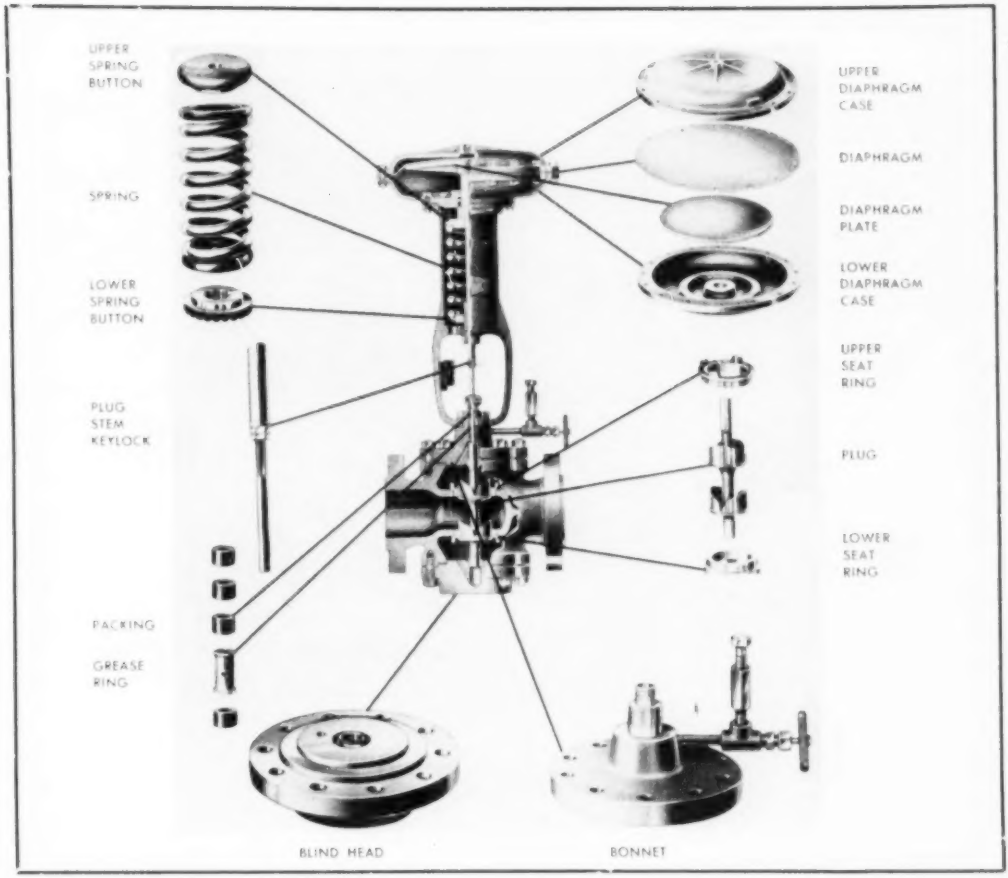


Fig. 60—Essential parts of an air-to-open, double-ported, equal percentage, diaphragm control valve.

REFINERY INSTRUMENTS

What Makes Them Tick?

Part 7—Control Valves

By **CORNELIUS E. SHANNAHAN,** *Instrument Engineer*
M. W. Kellogg Co., New York

A CHAIN is no stronger than its weakest link. Although the soundness of this statement is unquestionable, there is a tendency for many engineers to overlook the function of the control valve in the instrument cycle.

Perhaps the superficial simplicity of a valve disguises the due consideration it deserves to complete the control problem satisfactorily. For regardless of all the delicate treatment the measuring element and the controller may receive, it will be for naught if the control valve doesn't do the job it is supposed to do.

There are a number of very complete papers on control valve application. For that reason this discussion will concern itself with only a few salient points. The essential parts of an air-operated diaphragm control valve are shown in Fig. 60. This is a double-ported, equal percentage type valve. Control valves are also designed with single ports, but because of the problem of unbalanced force exerted on the plug of a single-ported valve, the double-seated type is usually preferable. However, where tight shut off is desirable, single seated valves are at an advantage. This is due primarily to the differential expansion between the body material and the inner valve, together with changes in temperatures of the medium in the line.

Another feature of the valve in Fig. 60 is that it is an air-to-open type. Air from the controller enters through the top of the upper diaphragm case and exerts a pressure on the diaphragm to overcome the force of the

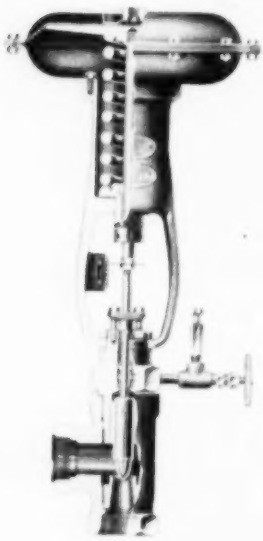


Fig. 61—An air-to-close valve of the same type

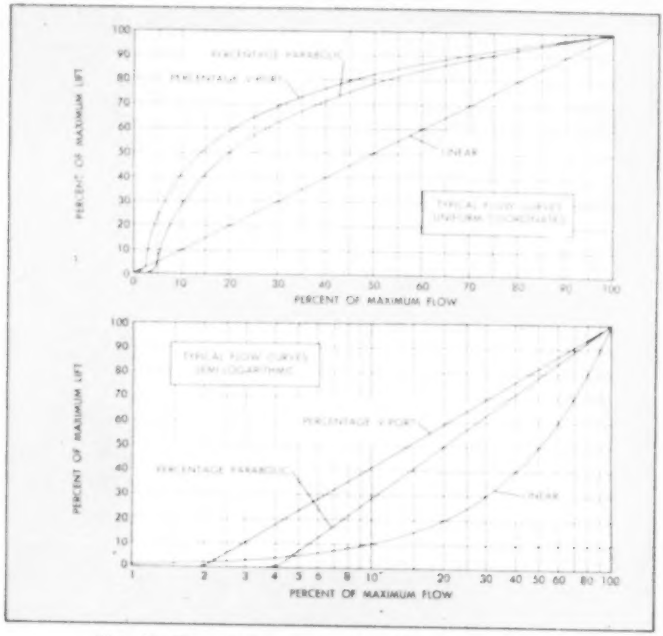


Fig. 62—Typical flow curves for three types of plugs

spring holding the valve closed, and thus opens the valve. Present practice is that the valve operates from fully open to fully closed, or vice versa, for air pressure changes from 3 to 15 psig. As illustrated then, the valve would stay closed until the air pressure just exceeded 3 psig, and would become fully open when the air pressure reached 15 psig. The other type valve, an air-to-close, appears in Fig. 61.

The question probably arises as to which type valve action should be used—air-to-open or air-to-close. This is usually determined on the basis of the safest position of the valve in the event of air failure. For example, if an instrument were controlling fuel gas to a furnace, it certainly would be safer for the valve to be closed in case of air failure. Once the type of valve action is established, the pilot action of the controller can be determined to control the process variable. If, for example, in the case just cited the fuel gas rate increases due to an upset, the pilot of the controller should decrease the output air pressure to the valve in order for the valve to close (it's an air-to-open valve). Whereas for a different process, if the valve were air-to-close, the pilot of the controller should increase the output air pressure to close the valve.

In sizing and selecting a control valve there are a number of points which must be considered. Among the most important are the allocation to the valve of a certain percentage of the overall friction drop between the terminal points of the process being controlled—usually referred to as the percentage drop—and the type of valve body and plug. Other problems have equal importance, of course, but aside from the question of valve material, these two are the instrument engineer's first concern. In order to evaluate these points better, it becomes necessary to understand first the mathematics involved in sizing a valve.

Basically, the same law of hydraulics as discussed in Part 2 of this series on flow measurement, PETROLEUM PROCESSING, Aug., 1951, pp. 818-533 apply to the control valve, e.g.

$$Q = A\sqrt{2gH}$$

where Q = volume rate of flow.
A = port area of the valve
g = acceleration of gravity
H = differential pressure across the valve in feet of flowing liquid.

Only in the case of the control valve, which is in effect a variable orifice, the expressions used are somewhat different. In the control valve, H is expressed in psi. instead of ft. of liquid, and the area along with flow constants are all grouped and referred to as the C_v of the valve.

Since $H = \Delta P / G_f$

where P = differential pressure across the valve in psi.
G_f = specific gravity of fluid at flowing conditions.

It follows that:

$$Q = C_v\sqrt{\Delta P / G_f}$$

When Q is referred to in standard units, which is the usual case, it must be multiplied by $G_f G_s$, where G_s = specific gravity of fluid at standard conditions. Also, since the expansion factor $(E.F.) = G_f G_s$, the above formula can be simplified to:

$$Q = C_v\sqrt{\Delta P / (G_f \times E.F.)}$$

If in the above formula, the flowing liquid were water at 60° F. and had a $\Delta P = 1$ psi., then $Q = C_v$, which is the manner in which the capacity of a valve is expressed in gpm. C_v can then be defined as the quantity of water in gpm. that a valve will pass in a wide-open position with a one lb. pressure drop. This is another way of saying that C_v substitutes for all of the constants in the hydraulic formula. For a 1-in. double-seated valve, the C_v is approximately 10. Since the area of a circle varies as the square of the diameter, it follows that as the valve size increases or decreases, the C_v will be approximately proportional to the square of the nominal valve size.

Thus for a 2-in. valve, $C_v = 40$. This relationship does not follow ex-

actly, especially in sizes smaller than 1-in., and will serve as a guide only. The above formula may be modified to more convenient expressions for calculating valves in steam and gas service, but the same basic principles hold true with one important exception. That is the maximum usable pressure drop cannot exceed more than one half the upstream absolute pressure.

It is only fair to mention that the rigorous analysis just discussed has been the subject of considerable controversy in this field. As a result, there are differences, sometimes considerable, between the capacities expressed as C_v of valves offered by different manufacturers. A number of reasons have been suggested, some of the sources of which are referred to in the bibliography. In general, the consensus is that—especially in larger size valves—there is little experimental data to support empirical relations. Along the same line, other authorities point out that the required flow characteristics cannot be expected in a valve operating at high differentials based on data extrapolated from the same valve operating at low differentials. This latter thought would suggest that valves would be more properly sized by the use of tables or nomographs.

In actual practice, as mentioned earlier, the decision as to the percentage drop and type of plug must be handled first. It is axiomatic of course that the valve can only control by absorbing and giving up pressure drop to the system. Most valve manufacturers recommend that between 40-60% of the friction drop in the system, exclusive of the valve, should be available as drop across the control valve. In many cases, the economics involved makes this allocation unreasonable. Therefore, where flow variations are small, a drop between 15-25% is acceptable. If further considerations become necessary, a close examination of calculated pressure drops as well as the actual pump characteristic curve is recommended. It is interesting to note in a continuous process, which is true in most refineries, control valves are not generally called upon to meet the rigorous duties they encounter in some batch operation applications. The reason for this is that once a unit is "lined out" there are not many occasions which arise to upset the conditions across the valve.

Before discussing the selection of valve plugs—as sometimes referred to as the control valve flow characteristic—a definition of the two most widely used characteristics, linear and percentage, would be in order. In making this definition it is necessary to assume that constant pressure drop is maintained throughout the entire lift, so that when speaking of flow we are actually concerned with the percentage of valve opening area. The linear valve characteristic, as illustrated in Fig. 62, is self-explanatory; i.e., for any percent of maximum lift, the same percent of maximum flow results. With the equal percentage, the percentage *change* in flow per unit change in lift is constant. For example, if the lift were to change from 20 to 30% of maximum lift for a percentage V-port valve, there would be an increase in flow of 48% (65 – 44)/44. For a change in lift from 40 to 50% of maximum, there would also be a 48% increase: (144 – 94)/94.

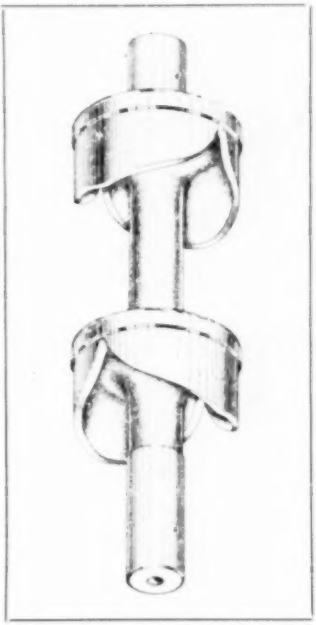


Fig. 63—A percentage V-port plug at left; a single-seated parabolic plug at right

The percentage characteristic is approached by a number of valve plugs, such as V-port, parabolic, ratio, and others. The basis on which to determine the correct type of plug for a system does not lend itself to generalities. Succinctly, the problem is to maintain a constant ratio between the change of flow with respect to change of stroke so that the same optimum setting of the control pilot can be retained for different loads. In systems where the pressure drop across a valve is fairly constant for various loads, the linear type is usually the more desirable. If, however, the pressure drop across the valve changes for various loads, then the equal percentage type valve is preferable.

In effect, the percentage characteristic attempts to linearize the change of flow to change of stroke relationship on installations where conditions of low flow, high pressure drop and high flow, low pressure drop are prevalent. The important thing to remember in this discussion of characteristics is that the type of valve has as much influence on the control of the installation as does the proportional band of the controller.

In Fig. 63, there are illustrated a double-seated, equal percentage V-port, and a single-seated parabolic plug. The preference for the parabolic plug (which is also available as a double-seated valve—see Fig. 61) arises in high pressure drop services usually greater than 100 psi, as it is less susceptible to erosion. In slurry services, and in fact in any gas or liquid carrying solids, the angle valve illustrated in Fig. 64 is usually specified because fewer changes in direction occur in this type valve, which also reduces the effects of erosion. The connection at the bottom of bonnet extension is used to flush the valve liner and thereby prevent the solids from entering either the liner or the stuffing box. An air fin bonnet is specified in services where the temperature exceeds 450° F., in order to reduce stuffing box temperature. For extremely low temperatures, extension bonnets are used to prevent ice formation on the valve stem with sub-

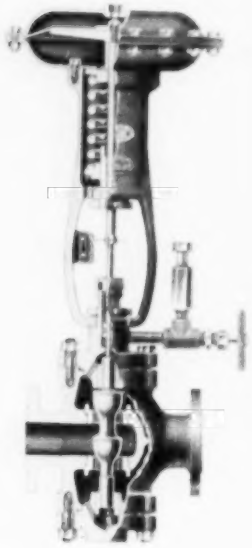


Fig. 64—An angle type, air-to-close valve, usually for slurry services

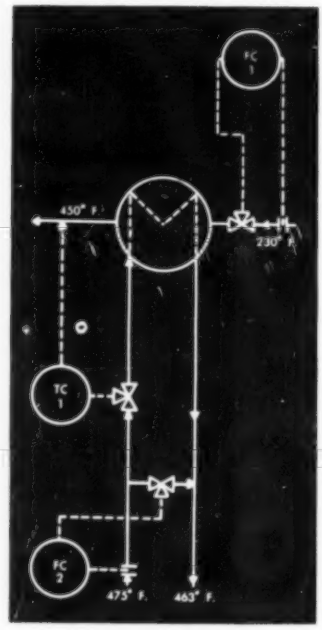


Fig. 65—Flow diagram of heat control example

expect valve stoppage by freezing.

Once the question of percent drop and type plug and valve have been resolved, the calculation of the valve size is comparatively simple. Before proceeding with this rather mechanical operation, however, it is usually well to consider the safety factors which have accumulated in the design of the system under consideration. For in the final analysis, it is the control system which bears the brunt of the responsibility for making the system operable. For this reason, valve sizing has often been referred to as more of an art than a science, and although there are occasions where this may be true, many others considered in the text can be arrived at by more systematic analyses.

A good example can be had in connection with a gas oil circuit which furnish the heat required for a number of heavy reboilers. For the purposes of this discussion, a single heat exchanger and associated instruments, as diagrammed in Fig. 65, will illustrate the problem at hand. The main control valve problem in this system is calculating the quantity that the by-pass valve FC-2 must pass. Since an exchanger is calculated on the basis of a fouled rate, it stands to reason that in a clean condition, it is capable of transferring more heat.

In order to evaluate better the problem, assume the following conditions:

Surface of exchanger
S = 220 sq. ft.

Overall fouled transfer rate
H = 49 Btu./hr./sq. ft./° F.

Overall clean transfer rate
H = 61 " " " "

Tube side clean transfer rate
h_t = 84 " " " "

Shell side clean transfer rate
h_s = 222 " " " "

Tube side fouling factor
= 500 " " " "

Shell side fouling factor
= 500 " " " "

Corrected log Mean Temperature Difference, MTD = 86.8 ° F.

Since duty, D, in Btu./hr., $H \times S \times MTD$, then D = 49 × 220 × 86.8 = 935,000 Btu./hr.

It stands to reason, of course, that the duty will increase, provided flow conditions remain constant, when the tube and shell sides are clean. The increase in duty would have to be calculated on a trial-and-error basis since as duty increases the terminal temperatures of the shell and tube sides would decrease and increase respectively, and therefore reduce the MTD.

With the control system operating as illustrated, however, TC-1 controller would pass only the required amount to raise the temperature of the shell side material to the required point. If this quantity can be calculated, then the FC-2 control valve must be sized to pass the excess gpd required by the exchanger. Since this calculation is also based on a trial-and-error basis, let us begin by assuming that the TC-1 control valve throttles the tube side material so that only 60% of design capacity is passed. Since the duty required to heat the shell side remains constant, it follows that the temperature change of the tube side must increase by 1.0/.6 = 1.67, to compensate for the reduced tube side flow.

Assuming the tube and shell side inlet temperatures are constant, the tube side outlet temperature would therefore increase to 475 − [(475 − 463) × 1.67] or 455° F. The corrected log mean temperature difference calculated on this basis equals 78.4° F.

Another correction must be made to tube side rate since it is a function of mass velocity. In the turbulent region, the tube side transfer rate is approximately proportional to the 0.8 power of mass velocity and to the 0.333 power in the viscous region. Assuming this example is operating in the turbulent region, h_t = 84 × (0.6)$^{0.8}$ = 56. The overall clean transfer rate then calculates to be: H = 156 × 222 ÷ 378 = 41.7 Btu./hr./sq. ft./° F. Since the surface of the exchanger remains constant, D = 41.7 × 220 × 78.4 = 770,000 Btu./hr.

This means that the valve has throttled too much, and therefore another trial is made with 80% of design capacity passing through the tube side. On this basis, the new corrected MTD calculates to be 83.1° F. and the tube side transfer rate 70.3 Btu./hr./sq. ft./° F.

Then H = 70.3 × 222 ÷ 292.3 = 54.5 Btu./hr./sq. ft./° F., and therefore D = 54.5 × 220 × 83.1 = 995,000 Btu./hr.

It follows that the required flow lies somewhere between 60 and 80% design capacity. If a closer approximation is desired, another trial can be made at 70%. By making a plot of duty vs. percent design capacity, the correct capacity for the clean exchanger can be plotted, as illustrated in Fig. 66. It should be pointed out that the duties calculated for the 60, 70, and 80% points are slightly in error due to the fact that the MTD's are based on a duty of 935,000 Btu./hr. Another assumption is that the specific heat of the flowing materials is constant, which is close enough within the usual ranges of refinery exchangers. The net result, however, is that the instrument engineer is able to arrive at a fairly intelligent answer as to how much the FC-2 valve must be expected to pass. For this particular case, the FC-2 valve must be sized to pass at least 25% of the design tube side flow rate. If the system becomes complicated by the addition of more exchangers in par-

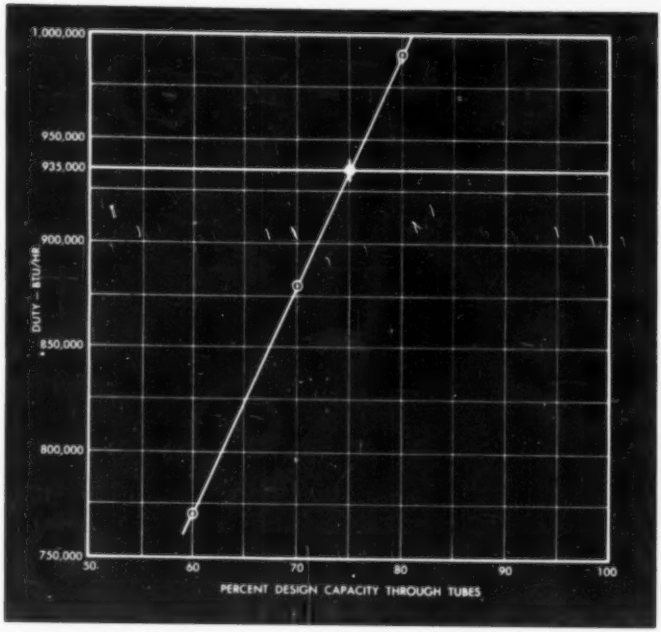


Fig. 66—Chart for determining correct capacity for a given specified duty

Fig. 67—A typical three-way control valve

alled in the same circuit, it means that the same analysis must be applied to each individual exchanger.

In the case of steam-heated exchangers, when the valve is located on the steam inlet, it is usually good practice to calculate the required *MTD* when the exchanger is in a clean condition. This enables the engineer to calculate the actual throttled steam pressure, and therefore the pressure drop the valve will be subjected to. This is of interest especially from a valve material point of view, because high pressure drop in steam service requires hardened trim.

Another place caution should be exercised is in the sizing of steam valves to the turbine drive of a pump. There is a general tendency to oversize these valves mainly due to an excessive accumulation of safety factors. This is especially true of slurry pumps, where the pump is justifiably designed for more than the process requires. As a result, the turbine rating is increased as well as the steam requirements, and by the time the system is put into operation, the valve will be working too close to its seat for good control, if proper precautions have not been taken. Installing a valve with reduced trim may be a possible solution so that as steam requirements increase with wear of the pump, it is necessary only to change the valve trim (e.g., seat rings and plug).

Occasionally, three-way valves are used on exchanger services to perform in one valve the same type service offered by the combination of TC-1 and FC-2 of Fig. 65. For this installation, the three-way valve could be installed at the junction of the bypass around the exchanger and its outlet, and be controlled by TC-1. A cross section of a three-way valve is shown in Fig. 67. As a general rule in this type of installation, it is preferable to locate the valves on the downstream side of an exchanger. This is due to the fact that the forces acting on the plug decrease as it moves in the direction of the line of action of these forces, and thereby stabilize the action of the valve.

It should also be pointed out that unless the resistances are equal through the two paths, a change in total throughput is effected as the valve moves to expose the area in one port that it has cut off from the other port. Although this can be overcome by the presence of other influences in the system, some caution should be exercised where the resistance through the two paths is considerably different.

Another type of valve which is sometimes used in a refinery is the direct acting regulator. This type controls pressure directly by having the controlled medium subjected directly on the valve diaphragm. Since it depends entirely on the process medium to do its throttling, it is limited in its stroke and therefore does not have as large a capacity as a comparably sized air-motor operated valve.

For those not familiar with the language of this field, it should be explained that the word "regulator" is sometimes used for valve types other than direct-acting. Certain applications which do not require close pressure control are furnished with valve-mounted pressure regulators which are tantamount to pressure controllers with a small proportional band. Since this pressure regulator is usually furnished with the control valve, the complete unit is commonly referred to as a regulator, although the valve proper is in no way different from those with a conventional air-operated diaphragm.

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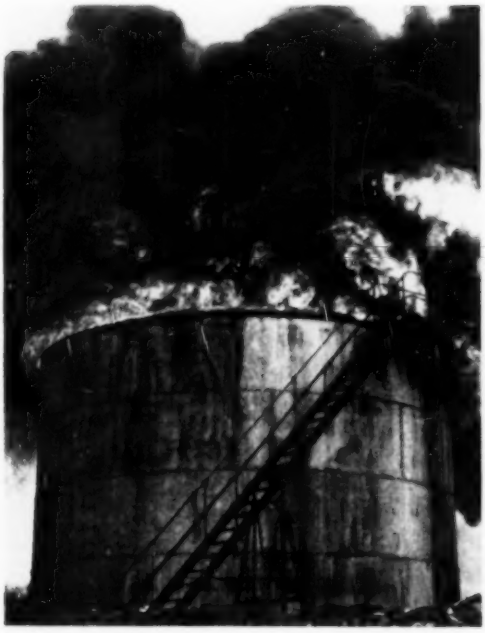


THIS TEST FIRE in a 30-ft. kerosine tank was • • •

PUT OUT IN 5 SECONDS with a new technique to • • •

Control and Extinguish Tank Fires By Agitating Contents with Air

A NOVEL method of tank fire control and extinguishment by using air to agitate the oil contents, bringing cooler oil from below to replace the hot surface liquid feeding vapors to the fire, has been developed by Socony-Vacuum Oil Co., Inc. The method was worked out by J. L. Risinger, company safety supervisor.

In the case of oils with flashpoints above atmospheric temperatures, the method is calculated to provide means of extinguishing a fire with regular operating equipment easily made available at tank locations. With crude oil and other oils with boil-over and slop-over characteristics, the objective is to eliminate these hazardous characteristics and to reduce the intensity of the heat and control the fire to make the extinguishing of the flames possible with less material and equipment than is used in present conventional methods.

A practical aspect of this means of tank fire extinguishment is that no intricate or costly devices are required to bring it into use. The small amount of air required at low pressure, can be pumped into the lower areas of the tank through pipes already installed for water draw-off, or for product pumping in or withdrawal. A pump capable of producing sufficient pressure to carry air into the tank at a sufficient rate (from 40 to 100 cu. ft. of free air per minute) is the only equipment needed which is not generally available at the site.

"Previous small-scale tests had proven", Socony-Vacuum reports, "that pools of oils with flashpoints above atmospheric temperatures can be extinguished by causing movement in the oil which replaces the hot surface oil feeding vapors to the fire with the oils below not heated to their flashpoints.

"It had also been determined in the small-scale tests that pools of crude oil can be successfully prevented from boiling over or slopping over by causing a movement of the oil itself in a manner to disturb the heat layer and heat wave.

"Tests have shown that air injected into the tank by special devices would set the crude oil in motion in a manner to disturb the heat wave and/or submerge the heat layer by replacing it with the cooler oil below. In these cases, the heat wave was not only disturbed and the boil-over and slop-over hazards killed, but the intensity of heat was reduced several times, and likewise the rate of burning."

After preliminary laboratory and field tests with the agitation method of fire extinguishment, experiments were conducted in a 30 by 30-ft. steel tank at the company's Olean, N. Y., refinery. The tank was equipped with various types of lines in the bottom for air injection. These included the regular 2-in. water draw-off line; a 3-in. perforated line across the center of the tank; 3-in. product line to tank center with upturned ell; 1½-in. perforated line around the tank wall; and a special spider arrangement of ¾ in. lines which would introduce air practically simultaneously to all sections of the tank.

Kerosine Fire Tests

In the test with kerosine the tank was filled approximately three-quarters full, containing about 18 ft. of oil and a 9-in. water bottom. The amount of oil was approximately 100,000 gallons of kerosine distillate of 47.4 API gravity, 126° F. flash point, 334° F. IBP and 522° F. FBP. The oil on the surface was ignited

and allowed to burn from 1 to 2 minutes before the air was turned on. The period from the time air entered the tank to extinguishment of the flames was from 5 to 45 seconds in 5 tests. The air pressure used varied from 6 to 10 lbs. and the amount of air required to cause extinguishment ranged from 6.25 to 68 cu. ft. Conclusions from the kerosine tests were reported by the company as follows, applying to fires in vapors of unheated oil with flashpoints above atmospheric temperatures:

"1—That fire in vapors in tanks or pools can be extinguished by turbulence of the oil caused by use of air, or perhaps the oil itself or other agencies. Air in volume and rate to do this can be supplied by cylinder or air compressor in variance with size of the tanks.

"2—That injection of air into any bottom connection, even through long lines, will provide necessary turbulence on small and medium sized tanks to extinguish fires.

"3—That air injection at reasonable rate, volume and pressure at center of tank or through perforated line across center of tank or through spider will extinguish the fire regardless of size of tank, and by use of small amounts, pressures and flow rates of air.

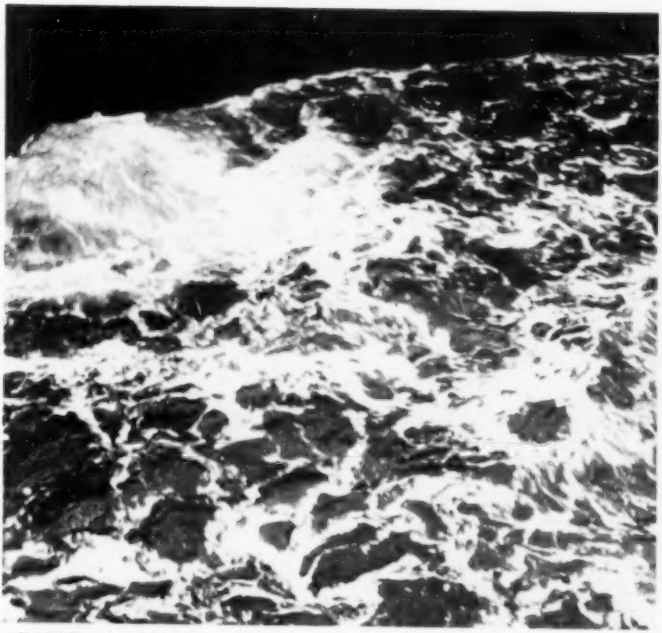
"4—Since center line arrangement of pumping into tanks appears to be prevalent, and this point of injection very effective, the use of air through this line on large tanks appears to be very practical.

"5—Any line used to stir up bottoms of oils can be used effectively to inject air and extinguish the fire."

The tests of the air injection method for prevention of slop-over and boil-over of tank fires were conducted with crude oil, since such oils contain all the characteristics of a boil-over. Boil-overs were described as occurring "when a heat wave from the burning surface travels down through the oil to the water in the bottom of the tank or suspended in the oil. The water is converted into steam. The steam cannot travel readily through the viscous oil above and therefore pushes it out of the tank." A slop-over is when the application of foam or water to a tank fire is in an amount sufficient to cause a frothing and expansion at or near top of the hot layer of oil which pushes some oil out of the tank.

Crude Oil Fire Tests

The 30 x 30-ft. tank was filled to about ¾ capacity, including a 12-in. water bottom. The depth of crude oil was about 18 ft., the freeboard above the oil being approximately 7 ft. The tank was an old one with the steel rusted away to almost half the original thickness, thus making the freeboard steel very susceptible to buckling from heat, which would have occurred if the fire had been allowed to burn uncontrolled for 10 to 15 minutes. The crude used was 44.2° API gravity; flashpoint below 0° F.; IBP, 132° F.; 78% off at 660° F. Since the purpose was to test the various injections of air to control and eliminate slop-over and boil-over hazards, switches from one air injection arrangement to another were made without extinguishing the flames.



SECRET OF SUCCESS in the new fire-fighting method is this turbulence, created at the surface of the burning liquid by injecting air into the tank bottom. Resulting agitation brings cooler product to surface in waves, reduces vapors on which flames feed.

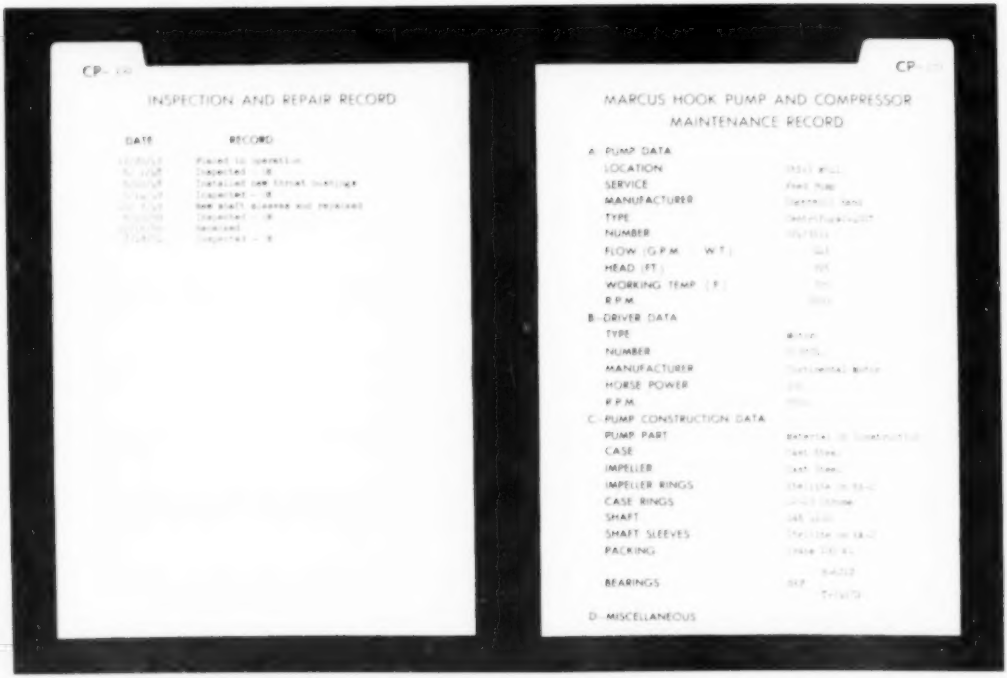
In one test, air ranging from 50 to 100 cu. ft./min. at 6 psi. was injected through the water draw-off. By the time the cold oil came from below and flowed across the surface, the flames had been reduced by one-third. The flames were further reduced during 5 minutes of air injection. When air was turned into the perforated pipe across the center of the tank, within 45 seconds the flames were brought down within the 7-ft. freeboard, with intermittent wind-swept flames above the rim. Air required was from 22 to 80 cu. ft./min. at 7 psi. With air injected into the spider, at 90 cu. ft./min. and 7.5 psi., the flames immediately came within the freeboard and very little smoke was noticeable.

In another test air was introduced through the spider and foam was applied through a 1½-in. mechanical foam nozzle, used from the tanks stairway platform. The foam was applied for 5 minutes, then the air was cut off and the fire was out one minute later. The mechanical foam required was two 5-gal. pails of 3% solution.

In tests extending about 2 hours and 15 minutes, to show how a fire could be controlled while preparations were made for extinguishment, no buckling or sign of serious weakening was observed in the shell above the tank liquid. The burning rate of the crude oil normally would be approximately 18 in. per hour. The rate in the test even with the preburn was 5 in. per hour. The heat wave in this crude would normally travel downward through the liquid at a rate of approximately 48 in. hour. In the period of the above tests a rate of travel for the heat wave of 8 ft.-4 in. might have been expected. Heat detecting paint showed that the heat wave did not travel downward at all during agitation.

The foam caused no frothing expansion, but laid on the surface of the oil in the same manner as on the surface of crude oil of 83° F. temperature which had not been ignited, this being the temperature of the crude throughout the mass after extinguishment.

In commenting on the test the company report stated: "There is no question but that when heat intensity is reduced noticeably by turbulence of the crude oil, and this heat intensity is held down by such agitation, a slop-over will not occur when foam or water is applied, and the heat wave will not travel to the water bottom and cause a boil-over."



RECORD FILE CARDS like this one (front of card at right, back at left) help tell you ...

How to Maintain Your Pumps

1—Order and handle all spare parts
2—Check pumping operation
3—Provide preventive maintenance

By **HOWARD F. THOMPSON**
Chief Technician
Sinclair Refining Co., Marcus Hook

A REFINERY pump maintenance and repair program can be most satisfactorily handled by a rather unusual organizational arrangement. The use of technical service personnel as advisory supervision and responsible to neither operating nor maintenance supervision.

This statement is backed up by four years of successful experience under such a plan at the Marcus Hook, Penna., refinery of Sinclair Refining Co. In this plant there are presently some 600 pumps about evenly divided in number between reciprocating and centrifugal types and also 16 large reciprocating compressors. These pumps and compressors, with their drivers, represent a capital investment of some $2,000,000, which well warrants specialized attention being given to their design, metallurgy, operation, and repair.

There is unfortunately a tendency on the part of the operating personnel in a refinery to view pumping operations as a "necessary evil," carried on with equipment so designed and sized by "penny conscious" engineers that it never has the capacity to do what the operator would like it to do.

Maintenance personnel often tend to view pumping equipment as a piece of machinery whose sole cause of failure is "lack of lubrication" by the operators.

To management, pumping equipment is a portion of the processing facilities which can readily "gobble up" an unduly large share of the manufacturing cost dollar.

Operating costs of pumping equipment are rather generally recognized, indeed to such an extent that appreciable increases in capital expenditures are authorized for relatively small increases in pumping efficiencies. Since pumping is so essential in petroleum refinery processing, it is wise for everyone engaged in this business to recognize all pumping costs. All too frequently the year-after-year drain of unduly high maintenance and repair costs for pumping equipment is lost in the overall operational cost figures.

In 1947, the expansion of processing facilities at the Marcus Hook refinery high-lighted the existence of some, and probably the birth of more, such pump problems. The following program was installed in an effort to solve them economically.

Considering a total of 600 or more pumping units, it is understandable that such equipment widely distributed among the different areas of this 100,000 b.d. (crude capacity) refinery can cause some confusion and even errors in the ordering of spare parts, in the changing of pumping duties, in re-locating a pump for service in another unit, etc.

As mentioned previously, in 1947 an attempt was made to lessen the

degree of confusion and number of errors by assigning 1½ men of the technical department to pumping equipment problems. One job was designated as pump inspector, and the technician functioning on it is engaged 100% of his time in working on these problems. The other technician spends about 50% of his time in helping to "trouble-shoot" pumping difficulties. Both men are graduate engineers with a background of considerable petroleum refinery experience. Because they function primarily in a staff rather than a line capacity, it was necessary that they sell the idea of reducing maintenance and repair costs to both operating and maintenance personnel and receive full co-operation in the project. The degree of co-operation obtained may be judged from the magnitude of the following outlined program set up for handling the usual "sore spots" of pumping operations.

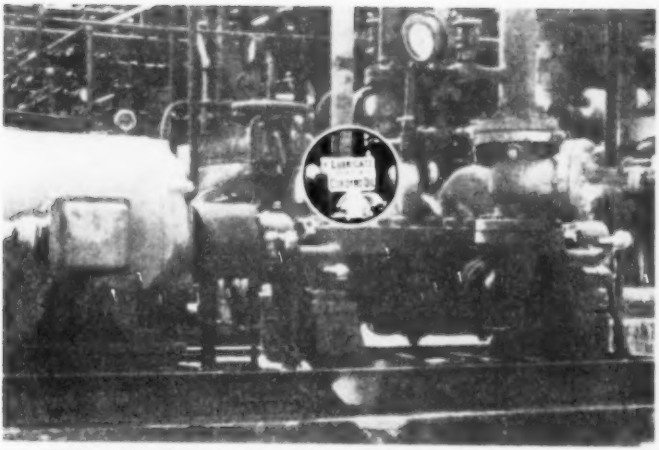
Ordering and Handling Spare Parts

The responsibility for having the necessary spare parts such as impellers, rings, and piston rods is assumed by the pump inspector. He prepares detailed requisitions for such materials, and upon management approval forwards them to the purchasing department. Such materials when received are placed in storehouse stock until needed. Authorizations for removal from storehouse stock with charges to the receiving unit are issued by the pump inspector. Thus there is one centralized source of information in the refinery for all pump spare parts and repair material.

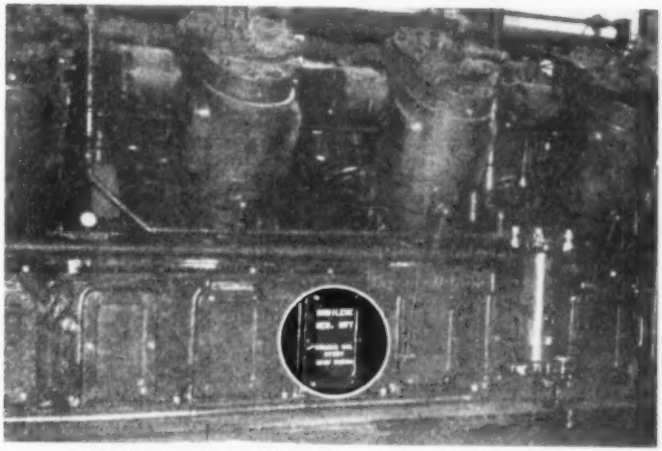
As regards to the number of spare parts to be kept on hand, the refinery pumping equipment is divided into a group of "must" pumps, which operate in severe services and are necessary for the continuity of processing, and another group whose operations are normally such that little or no wear occurs and they are not absolutely necessary for the continuity of processing. A definite supply of the usual wearing parts, in many cases complete rotating elements, is kept on hand for all "must" pumps. Repair material for the less essential pumps is taken care of by keeping on hand a limited supply of the usual wearing parts.

As an example, spare parts kept on hand for an important "must" unit like a centrifugal pump in slurry circulation service would include: rotating element, set of bearings, shaft sleeves, stuffing box bushings, front and back shrouds, shroud studs, shroud stud gaskets, and housing gaskets.

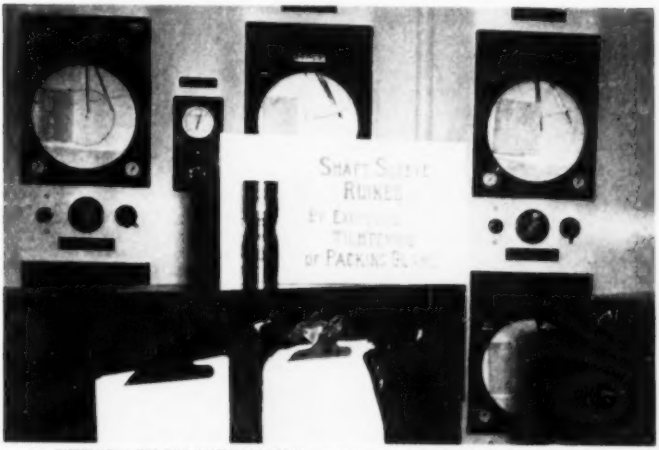
On the other hand, parts kept for a less essential unit, such as a centrifugal pump in kerosine transfer service, would include: set of bearings,



PUMP LUBRICATING instructions quickly seen on permanent sign



COMPRESSOR LUBRICATING instructions stencilled on casing



ERRORS IN MAINTENANCE pointed out by control house display

shaft sleeve, case wear rings, and impeller wear rings.

Although Sinclair Refining Co. does not have a policy of standardizing upon the equipment of a single manufacturer of a type of pump wherever possible an effort is made to obtain similar pumps so as to lessen the number of spare parts carried in storehouse stocks.

The pump inspector furnishes detailed processing specifications for new pumping equipment. These processing specifications are then incorporated by the engineering department on the proper requisition forms made in accordance with the Sinclair General Specifications Manual. This a rather complete description of the desired pump capacity, metals of construction, general design, and type of drives is furnished the manufacturers for bids.

Checking Pumping Operations

Responsibility for checking mechanical efficiency, use of the correct type of packing, and use of the proper lubricant in pump and compressor operation is assumed by the pump inspector. He maintains a card index file system (see Fig. 1) on which is detailed pertinent design and inspection data along with records of actual operation and major repair work for each such piece of equipment. In checking pumping equipment performance he makes use of such tools as thermometers, pressure gages, tachometers, indicator card mechanisms, and meters to obtain actual performance data for comparison with design data so as to evaluate efficiency of pumping operation.

Pump packing used in the refinery has been confined as far as possible to a packing manufactured in accordance with Sinclair specifications. Approximately 75% of the pumps in the yard are packed with this graphitized asbestos cord which has proven very satisfactory. The remaining 25% of the pumps are packed with materials found to be more suitable for their service. On the light hydrocarbon pumps, there are some 50 installations of mechanical seals which have proven very satisfactory. Packing difficulties have been most often experienced with high speed pumps and compressors, and it has been found that the usual source of such difficulty is a worn shaft or one that has been deflected in some way or another. The refinery pump inspector personally checks all difficult packing jobs as to (1) general mechanical condition of the packing mechanism and shaft passing through the same, (2) type of packing used.

Proper lubrication of pumping equipment is, of course, absolutely necessary for good pumping operations. As previously mentioned, even those engaged in the manufacture of lubricating oils sometimes forget this all important detail and/or cause equal damage by using a non-suitable lubricant. We know of no "sure fire" cure for forgetfulness. We have attempted to eliminate the improper use of lubricants by (1) stenciling on the cans the lubricant to be handled therein and (2) stenciling on the pumping equipment at point where lubricant is to be added, the name and grade of the lubricant to be used. We have found this stenciling to be of much help in keeping partially trained or careless operators from making serious pump and compressor lubricating mistakes.

A means of reducing refinery lubricating costs as well as the number of lubrication mistakes has been our standardization on the use of three grades of oil for refinery pumping equipment lubrication purposes. One of these grades is used for the ball bearing boxes of all centrifugal pumps of 3600 rpm speed; another is used in steam turbine bearings and 1800 rpm centrifugal pumps with Babbitt bearings; and the third is used in the steam chest of reciprocating pumps. All orders for lubricating oils and greases to be used in the refinery are channeled through the pump inspector. This method of ordering enables him to keep close check on the use, distribution and cost of refinery-used lubes and to quickly spot and correct any practices tending to get "out-of-line".

Preventive Maintenance

The pumping inspector checks at approximately three-month intervals all pumps and compressors in the refinery for general mechanical operation and condition. In this inspection, the equipment is checked for vibration, oil in bearings, condensate in bearing housing, condition of piston rods, condition of packing, etc. Anything observed "out-of-line" is reported directly to the machinist foreman who further checks this condition. Upon confirmation arrangements are made with the unit operating foreman to issue a job order for immediate repairs. This independent check of pumping equipment throughout the refinery by an experienced inspector has uncovered many incipent faults at an early enough stage so that a small immediate repair job has prevented a future major breakdown, or as proverbially stated "A stitch in time saves nine."

On exhibit in the various control houses of the processing units are packing glands, shaft sleeves, grooved rods, etc. that have been damaged by operators either improperly aligning or unduly tightening packing glands. Also on exhibit from time to time are burnt bearings caused by lack of or improper lubrication. The operators view these exhibits with interest and, we believe, such exhibits make a lasting impression of the results of improper treatment of pumping equipment.

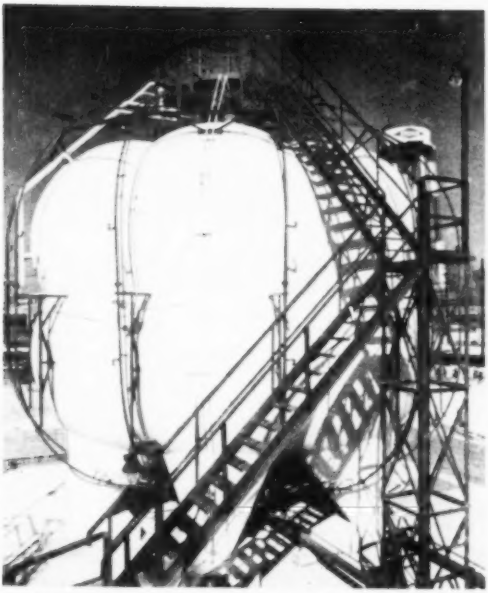
About twice a year qualified individuals from our own or other organizations lead a round table discussion on general refinery pumping equipment design, practices, repairs and lubrication. Representatives from all interested refinery departments attend these meetings and at some of the meetings the subject matter has been such and so detailed as to warrant the presence of the refinery pump and compressor machinists. It is our belief that such meetings are very worthwhile to refinery personnel and we are appreciative of the participation of the representatives of some of the leading pump and compressor manufacturers in these meetings.

Refinery processing is subject to frequent change. A pump purchased for a given flow and head may be desired to operate with different flow and heads, or be placed in service transferring an entirely different fluid. We believe another bit of very worthwhile preventive maintenance is accomplished by having the pump inspector thoroughly check all such proposed changes in pumping service as regards to metallurgy of pump and efficiency of pumping operation to be expected in the revised service. Time and again in proposed changes of pumping service we have found (1) that the diameter of the impeller may be cut so that the horsepower of an available driver will be sufficient for the revised pump service, (2) that the operating cost in the proposed revised service will be such that it would pay to buy another pump designed specifically for this service.

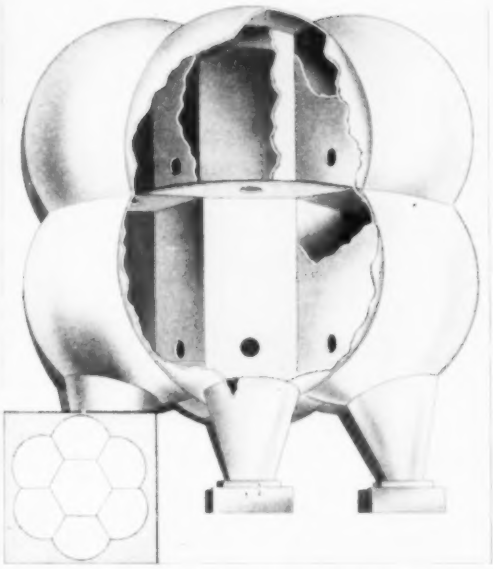
We feel that preventive maintenance work such as that outlined has paid off well during the past four years.

It is realized that the various refineries have used many other means of solving their pumping equipment maintenance and repair problems and that many of the practices listed in the foreground are common to all such solutions. As far as is known to this writer, the use of technical service personnel for advisory supervision of such work on a refinery wide scale is somewhat unusual. The functioning of these men is such that the direct responsibility for pumping operations remains, as it should, with the operating department and likewise the direct responsibility for repair work remains with the maintenance department.

The magnitude of the program brought into being and operated by $1\frac{1}{2}$ men indicates the appreciative co-operation of operation and maintenance with the intra-department liaison work of these engineers.



THIS MONTH'S COVER PICTURE shows the latest development in storage tanks for gases and liquids. Chicago Bridge & Iron's new Horton Multisphere.



SEGMENTS OF SPHERES form the shell, with all intersecting edges connected internally with flat plates, as shown in this sketch. Insert at lower left shows plan view.

New Type Pressure Storage Tank

UNLIMITED capacity in a single container is one of the main advantages claimed for the unusual pressure storage tank shown above—a Horton Multisphere.

In addition, substantial savings in steel may be realized when a single Multisphere is used in place of a number of cylindrical pressure tanks of the same total capacity.

A sphere, of course, is the best shape to withstand pressure. But there are two limitations on the size of sphere which can be built.

As a sphere gets larger it requires thicker steel plates for the shell in order to maintain its shape. Also, larger spheres result in more concentrated loads, so that they either are limited by the load bearing characteristics of the soil or require deeper and more costly foundations.

One source estimates that the maximum size sphere for storage of liquids is about 65 ft. diameter—or a capacity of 25,000 bbls. Beyond that, soil pressure gets to be excessive. For gas storage, 75 ft. diameter is considered maximum.

Engineers with Chicago Bridge & Iron Co. have figured out a way to outwit these limiting factors. They have designed a tank which has a shell consisting of a series of partial spheres. The entire skin is a grouping of continuous lobes or "bumps," each of which is a segment of a sphere.

As shown in the cutaway sketch above, the intersecting edges of all the partial spheres are tied together internally with flat diaphragm plates, both horizontally and vertically. Holes in the plates provide access from one cell to another and equalize the pressure in adjoining cells.

Any number of partial spheres can be tied together, in either direction. The particular Multisphere shown above, which has been installed at the Freeport, Texas, plant of Dow Chemical Co., is a 14-unit tank—six lobes around, two stories high, plus one lobe at the top and one at the bottom.

With this technique, it is possible to build a tank which uses the optimum plate thickness, regardless of tank capacity, by choosing the optimum radius of curvature for the pressure conditions to be met. This freedom of choice, according to CB&I engineers, makes practical the use of high-strength and relatively hard-to-weld steels, thus effecting a saving in metal, in freight and handling, and in welding.

The capacity of a single container is unlimited, since any number of cells can be tied together. If the load bearing limits of a soil are such as to put a ceiling on the height to which you can go, then the Multisphere can be kept low (one or two stories) and spread out as far as desired. "You can go a mile in either direction, if necessary," CB&I told PETROLEUM PROCESSING.

The Dow Multisphere is the largest such storage tank yet built, and is the first to be erected in the field. Some smaller ones have been shop-built. It is 31 ft.-4 in. across, 27 ft. high, and has a capacity of 2,500 bbls. It is used to store liquefied petroleum gases. The structure was tested hydrostatically at 225 psi. pressure and is designed for a working pressure of 150 psi. It is built of A-201 Grade B steel, and was designed in accordance with the 1950 ASME Code for unfired pressure vessels.

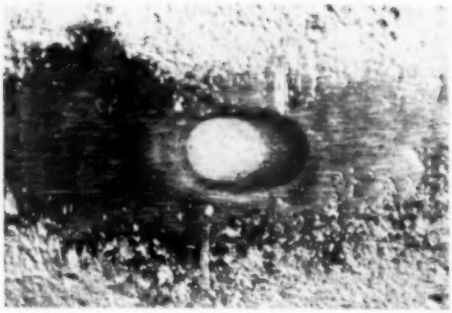
Much of the weight of a Multisphere is in the flat internal diaphragm plates. In the case of the Dow unit, the dished shell plates make up about 58% of the total weight of the tank, and the flat diaphragm plates make up the remaining 42%.

In general, CB&I reports, the ratio of the weight of flat plates to the total weight increases as the number of cells increases.

Several other advantages are claimed for the Multisphere. It requires just one set of fittings, whereas a battery of conventional tanks of the same total capacity would require a set of fittings for each vessel. The larger the tank, the smaller is the ratio of surface area to volume—thereby requiring less insulation than a number of smaller tanks with the same volumes.

Multispheres are covered by CB&I's U. S. patents 2,457,118 and 2,516,100.

THIS IS ALL the equipment needed for the new spot test — three bottles of nitric acid solutions and a file. The author is checking a 4-in. line in the field.



TYPICAL REACTIONS with the spot test are shown in these close-up views. **TOP** solution "A" on carbon steel; the spot has a light green center with clear edges. **BOTTOM** Solution "B" on 2% chromium steel; spot turns dark immediately and stays dark with a more or less vigorous reaction. This same reaction is obtained with this solution on carbon steel, and with solution "C" on carbon steel, 2% chromium, or 4-6% chromium steel, except that the vigor of the reaction, as indicated by the bubble formation, will be somewhat less with increasing chromium content.

HOW TO

Identify Chrome Steels Quickly

New field test method for alloys is simple to use, accurate within 1% chromium content

By H. M. RANDALL, Engineering Inspection Supervisor
Whiting, Ind., Refinery, Standard Oil Co., (Ind.)

A SIMPLE and rapid field test for identifying corrosion-resistant alloy steels according to chromium content has long been needed. Such a test has recently been developed by the Engineering Inspection Department of Standard Oil Co. (Ind.) at its Whiting Refinery.

This new test employs three nitric acid solutions of different concentrations to differentiate among many commonly used refinery alloy steels having nominal chromium contents ranging from 2% to 12%. It should enable the operator to determine the chromium contents of such alloy steels to within ±1% chromium.

The test is very simple to use and requires a minimum of equipment. It has performed well in the field under many different conditions, and has been of great value in the speedy determination of chromium contents in steels that are in general refinery use.

Why Test Is Needed

It is important that the various grades of chromium steel be segregated and properly identified in the field, since corrosion rates, fabrication procedures, and types of welding electrodes used vary with the different chromium contents, as do the design criteria.

Due to unforeseen delays encountered in field fabrication, piping and fittings often rust heavily before they are put in use and it then may be impossible to properly identify the alloy from the original markings. Frequently small size stock is received

in bundles with the pieces unmarked individually. After the bundle is broken there may be a good chance of the material being mixed with different stock or otherwise losing its identity.

The positive means of determining the chromium content of steel is to cut a piece from the material and have it chemically or spectrographically analyzed. This method, however, takes time and money, besides destroying some of the material. Chromium determination by spark testing is another method, but it requires an expert operator and exacting conditions; moreover, it is not adaptable to differentiating among all of the alloys listed in the accompanying table.

Solutions and Procedure

The three solutions required for the new field test method are:

A. Concentrated nitric acid (HNO_3).

B. Ten (10) parts, by volume, of concentrated nitric acid (HNO_3) diluted in eleven (11) parts, by volume, of distilled water.

C. Six (6) parts, by volume, of concentrated nitric acid (HNO_3) diluted in eleven (11) parts, by volume, of distilled water.

The solutions should be stored in glass stoppered bottles (50 ml. is a convenient size) to prevent evaporation. (Cork and rubber stoppers are attacked by the nitric acid.) The solutions will remain at proper strength for a month or two under normal usage. When the solutions produce reactions on control samples that are inconsistent with those listed in the accompanying table, they should be discarded and fresh solutions prepared.

The procedure to be followed is to file or grind a small spot on the surface of the unknown material until it is bright and free of oil, dirt and rust. (Grinding is preferred to filing because of the smoother surface produced, but the accuracy of the determination is reduced very little because of a rough-filed surface.) Then place one drop of the acid solution chosen on the prepared spot and notice the reaction.

Descriptions of the reactions listed in the table are subject to individual interpretation, but the reactions themselves are nevertheless definite and easily recognizable. It is recommended that the operator use small samples of steel of known chromium content (as determined by check analysis, if possible) to familiarize himself with the various reactions and to maintain a check on the concentrations of the acid solutions.

Observe These Precautions

Following are several precautions to be observed in conducting these tests:

1. If a file is to be used for the surface preparation, it should be reasonably clean so as not to smear a foreign alloy on the piece to be identified.

2. Bad lighting could possibly cause the operator to be deceived by the acid reaction; under such circumstances, several spots should be tried and the reaction observed from different angles.

3. A wide variation in the carbon content (beyond usual specification tolerances) could conceivably introduce a slight error into the determination. Depending on the carbon content, more or less of the chromium would be available to resist chemical attack than in the usual alloy and hence a slightly different reaction might occur. However, this effect has not been found to have any practical significance in the usefulness of the test.

4. Severe chromium segregation, as has been found in some castings, could throw off the accuracy of the operator's decision with respect to the average chromium content of the entire piece. Trying the reaction on several different spots should disclose any such condition.

5. With some of the chromium alloys, the chemical reaction of the acid solution is very fast and the appearance of the drop changes rapidly; therefore, the operator must be prepared to observe the results directly upon applying the solution to the metal.

6. A decrease in metal temperature (winter testing) slightly decreases the speed of the chemical reactions.

7. As the chromium content increases, the resistance of the alloy to attack by the various nitric acid solutions also increases. Thus there are various gradations in the appearance of the reactions on different samples of the same general alloy. A case in point is that of the 4-6% chromium alloy tested with solution B. If the chromium is on the low side of this specification, the acid drop will turn dark and then light several times and a dark ring will form around the drop. On the high side of the 4-6% chromium specification, the drop will turn from dark to light and the reaction will stop. With experience the operator will be able to discern between these slightly different reactions and will become more accurate in his determinations.

8. The 12% chromium alloy cannot be differentiated from the austenitic stainless alloys (e.g., 18-8, 25-12, 25-20) by means of this test; however, the fact that it is magnetic renders it otherwise easily distinguishable from them.

These steels . . . . . give these reactions

% Cr.	Solution	Reaction
0	A	Drop turns light green immediately.
	B	Drop turns dark brown; vigorous reaction.
	C	Drop turns dark brown; vigorous reaction.
1		Same as above; cannot distinguish between these two by this test.
2	A	Very slight reaction; drop remains clear and colorless.
	B	Drop turns dark brown; vigorous reaction.
	C	Drop turns dark brown; vigorous reaction.
5	A	No reaction.
	B	Drop turns dark brown and then becomes clear and colorless.
	C	Drop turns dark brown.
7	A	No reaction.
	B	No reaction.
	C	Drop turns dark brown and then becomes clear and colorless.
9	A	No reaction.
	B	No reaction.
	C	Very slight reaction; leaves light stain (dull spot on the bright surface) after one (1) minute.
12	A	No reaction.
	B	No reaction.
	C	No reaction.
12 (Type 416)	A	No reaction.
	B	Slow reaction; drop turns gray.
	C	Slow reaction; drop turns gray.

New Type Forms Provide Closer Control of Refining Costs

A new type of accounting form for recording refining costs for control purposes, being adopted by Atlantic Refining Co., provides for a breakdown of charges for labor, services and staff department overhead which are frequently lumped into overhead. Data are given for an analysis of variations in costs. The same type form described here for processing costs is used for utilities costs, service functions, overhead accounts and total operating costs for each refinery. Another new type form, for top management, shows by months total expected and actual costs and also provides for analysis of variations in major expense items.

This paper was presented before a Financial and Accounting Group session at the 31st Annual Meeting, American Petroleum Institute, Chicago, Nov. 5-8, under the title "Cost Control in Refining Operation."

By VERL L. ELLIOTT, Controller
Atlantic Refining Co., Philadelphia

THE subject of refinery cost control is a broad one and the phase I would like to cover briefly relates to the kind of information supplied by the accounting department to refinery management, and covering the operating costs of their various processing and service units.

We do not prepare inter-departmental Profit and Loss Statements. We, therefore, do not on our books charge the refineries for the cost of the crude oil they consume nor the costs of transporting the crude oil to them. For that reason you will not later see any references to the cost of raw materials charged to each process, nor the values placed on the products from them.

I do not mean to leave the impression that we do not require these data because, of course, many economic studies are being made continuously using such data, but they are of the memorandum variety and do not become a part of our official refinery cost accounting records. Neither do I mean to leave the impression that we do not record charges made to the parent company by our subsidiary companies, because we are obliged to do this also, as you all know.

I believe the best way to review my assigned subject is to show the forms that we are utilizing for cost control in our refineries and to discuss briefly with you some of the reasons why the forms are laid out as shown.

Form No. 1 is one that we have developed for use beginning in January, 1952 after having had several years experience with a form of the same size, but slightly different account headings. This particular form will be utilized for recording the process costs of all of the operating units; that is, the crude oil distillation units, thermal and catalytic cracking plants, lubricating oil plants, our chemicals plants and so forth. The same type of form will be used for departmental summaries of process units; also for steam, air, electric power, water, trucking, wharfage operation, etc. Our overhead accounts are also recorded on this type of form as well as the total cost of operating each refinery.

The actual cost data are hand posted to these forms from tabulating summaries by the personnel of our refinery cost and yield section, who also enter the allowances.

Note that the form has space for each month's expenses for the whole year, with quarterly and annual totals. The same form is reproduced each month showing the current month and all the preceding months in that year. The report for the preceding month can then be destroyed, retaining at the end of the year the December issue which contains data for the whole year. In many of our reports we follow this practice of showing figures a year or more back for comparative purposes and especially to show trends. Where practical and convenient we use charts for the same purpose.

Getting now into the body of the form, the first 8 lines as titled at the left are a dollar and a throughput summary of the operation for convenient reference, particularly by the plant manager, who will request his subordinates to explain significant variations in all items through line 52.

The reason for the term "Total Allowances" on the second line and throughout the form bears some explanation. We have a standard cost system for our refineries which has evolved from an initial installation made for use in 1931. As presently operated, the system makes use of two types of allowances. The first type would include operating labor, repairs labor, repairs materials and expense general. These are estimated as dollars for each month quarterly in advance by the supervisor of the unit and for which estimates he is held accountable.

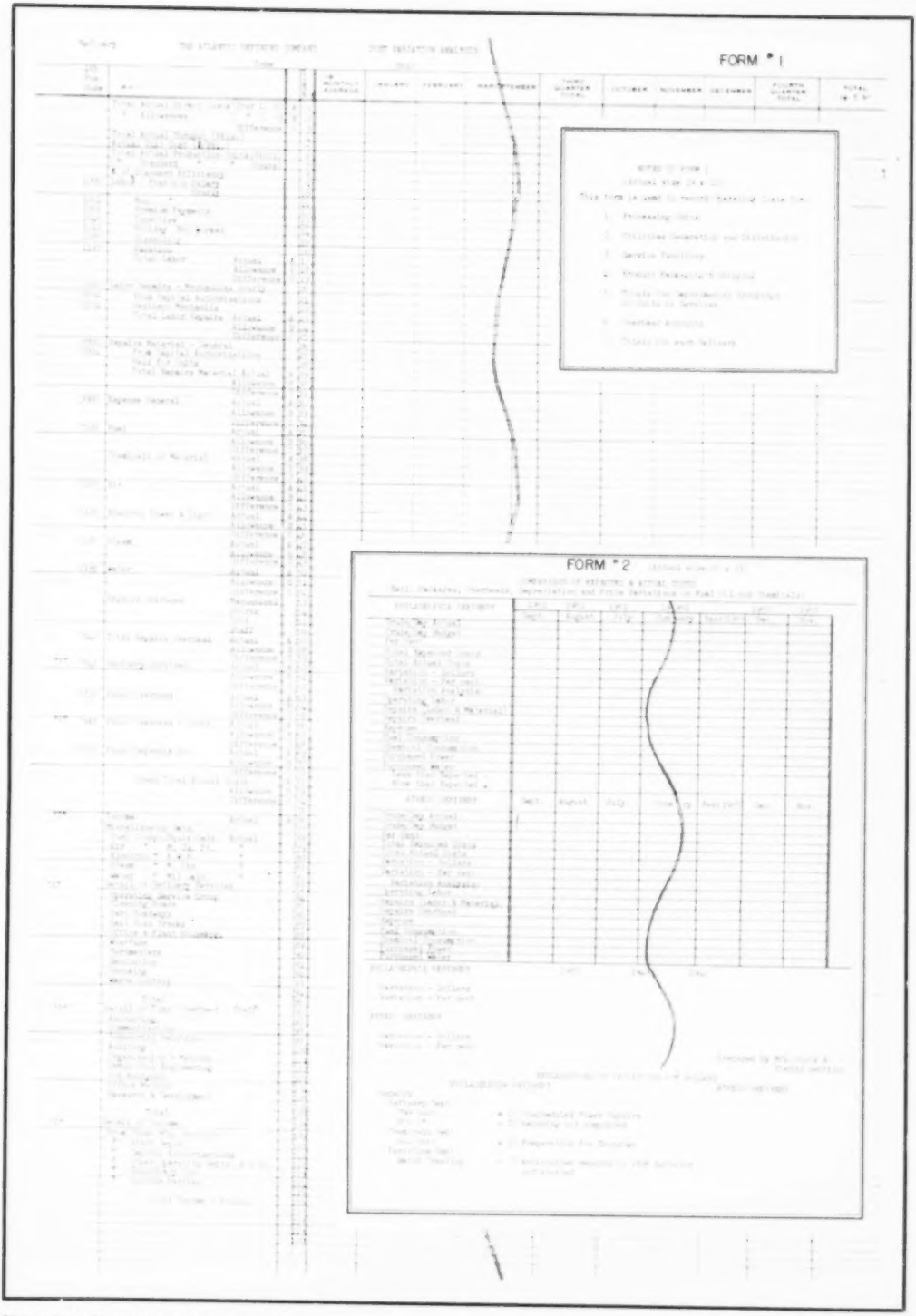
The other type we refer to internally as standards and includes steam, fuel, chemicals, etc. These standards are based on engineering and test data and are derived by our research and development department representing an independent agency. The research and development department submit their proposals to a plant standards committee, whose membership includes representatives from the operating, research and accounting departments. The committee exercises control over the gen-

RIGHT—Cost analysis simplified with these forms

Meet the Author

Verl L. Elliott, a native of Kansas, received his early education in that state and graduated from the Evening Wharton School of Accounts and Finance of the University of Pennsylvania in 1921. He has been with the Atlantic Refining Co. at Philadelphia since 1921 and has been Controller since 1926.

He has taken an active part in the work of the API Committee on Uniform Methods of Oil Accounting and was chairman of the committee for three years. At the recent API meeting he was awarded the first API Certificate of Appreciation for work on this committee.


FORM * 1
FORM * 2

cral policy regarding the standards as well as their specific application to a given unit. These standards are on a per-barrel basis ordinarily and allowances for each of the expense items mentioned are calculated by multiplying the actual barrels of each stock charged times the respective standard for that stock.

The research and development department has also established standard times for operations. Refinery supervision can then determine whether the plant is being operated efficiently from a throughput as well as from a dollar standpoint.

Following this summary, lines 1 through 81 are the detailed items of operating expense, with provision both for the actual cost and the respective allowance.

You will note that under the "labor" heading on this form we include items of Holiday payments, Disability payments and the like. At one time these were handled exclusive as a part of overheads, but we now believe we obtained much better control on the part of our supervisors if they appreciate fully the size of these items by having the actual bill charged to them. It is now brought home to them forcibly that when they hire a man they are paying a substantial premium for him in addition to the rate shown on his time card. Our payroll people have been able to devise means whereby a reasonable breakdown of this information to each operating unit is possible without significant added clerical cost.

The items following "Labor" are self explanatory. The expense item I would like to discuss with you next is entitled "Refinery Services", line 60.

Into this "Refinery Services" grouping we have included the items shown in detail on lines 83 through 95. I think you will recognize that most of them are essential to refinery operation, but also are the kind that the foremen of the processing units are likely to take for granted. Some of these will be distributed as prorates; others will be based on an analysis of the service rendered. The main point is we are trying to get them accepted by the operating personnel not as overheads, but as essential services performed for them and legitimately chargeable to them.

The next two items — "Plant Overhead" and "Plant Overhead Staff," line 63 and line 66, we can discuss together.

In order to be popular today with the operating supervisors in the refinery, the refinery cost accountant must utilize one of the by-products of the crude producing department. He needs the deep dry holes in which to dump those rapidly increasing overheads so that they will be forgotten by all concerned. Unfortunately for his personal popularity, the refinery cost accountant, or accountants in any other branch of the business for that matter, is unable to do this. It frequently is necessary for the cost accountant to remind the operating supervisors that the accountant does not spend the money represented by these overheads, or not much of it at any rate, but his primary concern is a proper allocation of such expenses to assist in developing adequate control means to keep them in line. Staff departments of any kind seem to grow in only one direction: LARGER. The ever-increasing size and number of the "Fringe" items adds more and more to operating expense and no one likes to pay for them.

We cannot in this short discussion treat adequately the subject of overheads as you well know. I can, however, indicate that with their increasing size and complexity we are devoting a proportionately larger share of our cost accountant's time to the recording, distribution and analysis of this type of expense.

For purposes of accounting convenience we make charges of the staff departments that serve the refinery to the refinery plant overhead account. For purposes of distribution, however, these are broken down into the two separate items shown. This enables the operating supervisor to differentiate between the charges for which he and his own plant manager are directly responsible and those which they incur when they utilize the services of the staff departments. These latter would, of course, include accounting, industrial relations, industrial engineers, methods department, etc.

The "Plant Depreciation" and the "Grand Total" items are self explanatory as shown on lines 69 - 71.

Some of our processing operations will have by-product steam generation for which credit will be given to their operating cost. These would be recorded on the "Income" line, 76. On a refinery-wide basis "Income" can arise from a variety of situations. For example, a staff department may be charged for the utilities they consume, or other branches of the Company may send in repair work to be done in the refinery shops. The cost of these services where practical is charged to the respective department and we consider the credit to the refinery as income.

Following the "Income" account and beginning on line 77 is a group of miscellaneous entries where we record the quantities of utilities or chemicals consumed. This is also for a convenient reference as the dollar cost of such items is included in the appropriate space above.

Beginning on line 83, we next list the allocated costs of the several functions that make up our "Refinery Services" group. The supervisors of all these separate functions report to refinery management.

Time does not permit a description of each one nor the reasoning for their inclusion under this heading.

The charges allocated to the manufacturing department by the staff departments are shown separately by these departments beginning on line 96. At the present time we do not contemplate making any more detailed distribution of these than to the several departments within the refinery. That is, each departmental superintendent will see the information but it will not be passed on routinely to his subordinate supervisors in charge of specific units or groups of units.

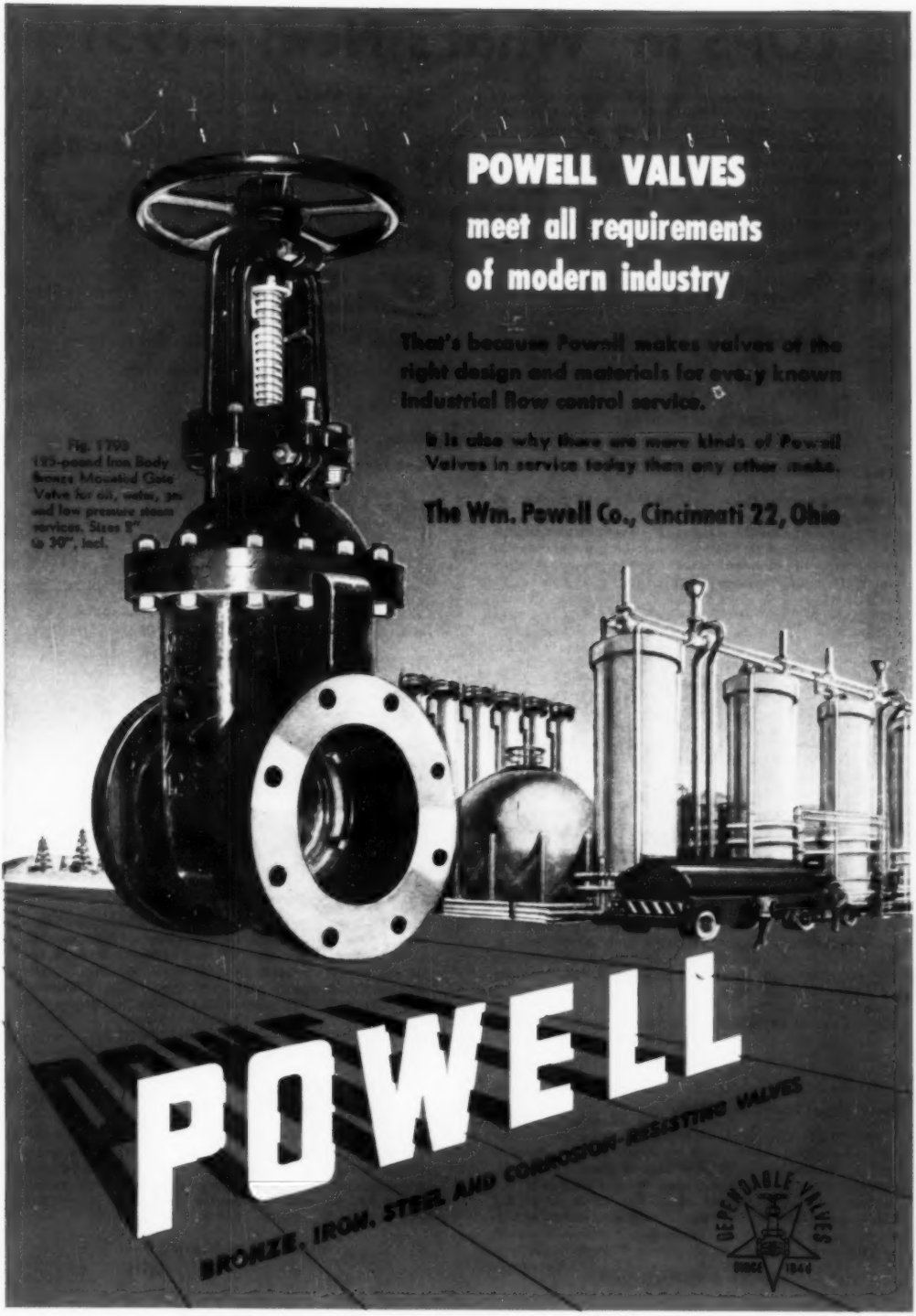
"Total income" as shown on line 76 is detailed on lines 108 through 116 into the following sources of income insofar as the refineries are concerned:

1. Other Manufacturing Accounts (Line 109)
2. Staff Depts. (Line 110)
3. Capital Authorizations (Line 111)
4. Other Operating Depts. A.R.Co. (Line 112)
5. Subsidiary Companies (Line 113)
6. Outside Parties (Line 114)

You appreciate that detail of the kind discussed above is necessary for the control of expenses on the "firing line". However, top level management in these days cannot find time to consider so many figures. The principle of control by exception is utilized to an even greater extent at this level and for that purpose we have for some time prepared a report which we have reproduced on this same page under the heading of Form No. 2.

You will note this form has a separate section for each refinery and shows at the top our forecasted and our actual crude run and a percentage comparison of these two figures. We next show our total actual costs and our total expected costs and a difference in both dollars and %.

Following these difference figures is an analysis of the major expense heading under which differences occur. At the bottom of the form, space is provided for the accountant to record those differences significant enough to warrant specific mention to top level management. Many of the differences arise from repair shutdowns occurring either before or after they were scheduled, and in many other cases because the operating supervisor neglected to forecast some maintenance or other work that subsequently occurred. In fairness to the operating man, however, we must acknowledge that he cannot predict exactly when a breakdown is likely to occur.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125-pound Iron Body Bronze Mounted Gate Valve for oil, water, gas and low pressure steam services. Sizes 2" to 30", incl.
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DEPENDABLE VALVES
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TOPS in "What's New!"—1951

Here are brief repeats of the most interesting items reviewed in the monthly "What's New!" section during the year just finished. As a service to readers who might have missed them, may not have been receiving PETROLEUM PROCESSING before, or may now find them of value in their work, the editors have assembled the "Tops in What's New! 1951" on these two pages.

A code number has been assigned to each item. Readers are invited to use the regular Reply Cards, which they'll find between pages 104 and 105, to request further information about equipment or copies of the helpful trade literature.

High Capacity Compressors

Centrifugal Multi-Stage Compressors, Bulletin 116, 36 pages of thorough catalog information on a line of compressors with capacities from 1000 to 65,000 cfm.; including a detailed six-page section of engineering data and performance characteristics allowing estimation of power requirements, rotative speed, and discharge temperature for most applications. Clark Bros. Inc., 600 Lincoln Ave., Olean, N. Y.

Circle No. **1** *on Reply Card*

Fractionating Tower Trays

Glitsch Truss-Type Bubble Trays, Bulletin No. 150; 24 pages of engineering information, drawings, photographs on fractionation column internals, their design, fabrication, and installation. Fritz W. Glitsch & Sons, Inc., 4800 Singleton Blvd., Dallas, Texas.

Circle No. **2** *on Reply Card*

Welding Fittings Data Card

TF Dimensional Data Card of Welding Fittings and Flanges; consolidates on two sides of an 8½ x 11 in. card, specifications on fittings for every nominal pipe size from ½ through 30-in.; and on flanges for nominal sizes from ½ through 24-in. Taylor Forge & Pipe Works, Box 485, Chicago 90, Ill.

Circle No. **3** *on Reply Card*

Refinery Valve Specifications

Nordstrom Valves, Specifications for Petroleum Refinery Services; stiff-cloth, ring-type binding, containing complete set of bulletins with full service conditions and specifications, diagrammatic flow charts, and concise description on 19 present-day important petroleum processes and their valve requirements. Rockwell Mfg. Co., Nordstrom Valve Div., 400 North Lexington Ave., Pittsburgh 8, Penna.

Circle No. **4** *on Reply Card*

Longer Life from Condenser Tubes

Life Extension for Condenser Tubes; a 28-page brochure giving technical information on the causes and the means of combatting corrosion in copper and copper alloy condenser tubing; including a table of general service recommendations for various alloys. Revere Copper and Brass, Inc., 230 Park Ave., New York 17, N. Y.

Circle No. **5** *on Reply Card*

Helpful Corrosion Information

Beyond Your Blueprints; a 16-page catalog on steel and alloy plate fabrication of tanks and vessels for petroleum and chemical processing; including a helpful table listing the corrosion resistance values of 16 commonly used metals with reference to several hundred chemical compounds. Nooter Corp., 1400 So. 2nd St., St. Louis 4, Mo.

Circle No. **6** *on Reply Card*

Giant Lube Oil Plant

New Horizons, Lummus at Cit-Con; a 24-page pictorial brochure giving a refinery tour in pictures of the Cit-Con Oil Corp.'s new lubricating oil refinery at Lake Charles, La. The Lummus Co., 385 Madison Ave., New York 17, N. Y.

Circle No. **7** *on Reply Card*

Gasoline Storage Tank Cleaning

Tank Talk; a 50-page, pocket size booklet concerned with the safe procedures for entering and cleaning leaded gasoline tanks, and safe removal and disposal of sludge; in cartoon pictorial style similar to many of the World War II Armed Forces manuals. Du Pont Co., Petroleum Chemicals Div., Wilmington 98, Del.

Circle No. **8** *on Reply Card*

Steel Pipe Technical Data

B&W TDC 138 gives data on seamless and welded pipe of carbon, alloy, and stainless steels; Table I listing dimensions in 16 sizes of pipe from ⅛ to 8 in. nominal size, with five different weight schedules according to wall thickness and I.D.; Table II giving ASTM and ASME specifications with grades and analyses for high temperature and other services. Babcock & Wilcox Co., 85 Liberty St., New York 6, N. Y.

Circle No. **9** *on Reply Card*

Corrosion Notebook

Notebook on Corrosion Resistance; 16 pages of data on corrosion resistance of various types of stainless steel tubing and pipe, by type of corrodent at various concentrations; and including descriptions of general types of corrosion. Carpenter Steel Co., Alloy Tube Div., Union, N. J.

Circle No. **10** *on Reply Card*

Remote Level Readings in 3 Seconds

Readings in three seconds from 1 to 48, or more, oil storage tanks at a central control station is possible with the Natasco Model 70 Electric Remote Reading Liquid Level Gage. The instrument embodies a simple AC selsyn (self-synchronous) system, consisting basically of one selsyn motor in the transmitter at each tank and one in the receiver. Accuracy is said to be within 1/16 in., and 1 in 360 arcuate degrees. Conventional float system drives the transmitter selsyn mechanically. An unlimited number of transmitting selsyns can be connected to one receiving selsyn. Calibration is never necessary because of the permanent synchronization of the two selsyns in any given circuit. The system requires 110 volt A.C. power, or it will operate on storage batteries with the use of a vibrator-type rectifier. The Natasco Co., Box 1318, Tulsa, Okla.

Circle No. **11** *on Reply Card*

Graphic Calculator

Statisticians in quality control, engineering research, and the like will find the new desk calculating instrument, the Merrill RMS Slide-Disk, simplifies the computation of standard deviations, root-mean-squares, correlation coefficients, regression lines, etc. Using a graphic calculation method, it obtains statistical results in a fraction of the time previously required, and to an accuracy of ½% or better, it is said. Five mathematical steps are performed in one mechanical operation taking about two seconds. Computing personnel can learn to operate the Slide-Disk in a few minutes. The device consists of a 10-in. disk that slides and rotates under a pair of vertical and horizontal scales on which a series of right triangles are formed graphically. Making use of the Pythagorean Theorem, operations of squaring, summing squares, and square-rooting are performed simultaneously and rapidly. The Slide-Disks are furnished with linear and logarithmic scales and an instruction manual. All critical parts are made of Vinylite plastic. Graphic Calculator Co., 633 Plymouth Ct., Chicago 5, Ill.

Circle No. **12** *on Reply Card*

Tiny Metering Pump with Wide Uses

Applications for the "mini-Pump" include both laboratory and production service. A controlled volume, positive-displacement pump that handles liquids in capacities from 3 to 800 cc./hr. with accuracy, at pressures to 1000 psi.; it can be used for injecting inhibitors into liquids, odorants into gases, automatic titration, proportional blending of two or more streams, and continuous sampling. It has a reciprocating plunger of ⅛ in. diameter. A cam, driven by a fractional hp. motor, actuates a spring-loaded cam follower on the plunger. A graduated screw adjustment limits plunger travel and changes displacement. Pump is available in simplex, duplex, and multiplex models. Milton Roy Co., 1406 East Mermaid Lane, Philadelphia 18, Penna.

Circle No. **13** *on Reply Card*

Lab Fractionator Makes Fast Analyses

A new adsorption fractionator provides accurate analyses of light hydrocarbon gases through the C_4's in from 1 to 3 hrs. with approximately 300 ml. of sample. Previously available methods require 6 to 8 hrs., it is stated. In the new apparatus, gases are separated, identified, and measured by volume of separated fractions. Separation is by physical adsorption. Identification is by measurement of the thermal conductivities, and the volume of each fraction is obtained by determining the pressure change in an evacuated system. Accuracy of about 0.2%. Identifications and measurements of the gas fractions are recorded on a potentiometer, for a complete and automatic record. Operators need not be skilled. No liquid air or other refrigerants are needed. Dimensions of the unit are 3 ft. wide, 2 ft. deep, and 6 ft. high. Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Penna.

Circle No. **14** *on Reply Card*

Variable-Area Flow Transmitter

The "V/A Cell" is a new flow transmitter developed for differential pressure applications. It is mercury-less, but does not utilize a diaphragm. It is basically a through-flow instrument of the variable-area type which measures a by-passed portion of the main flow. Continuous self-purging is therefore provided. A patented magnetic coupling follows float position and converts flow into proportional air for transmission to receiving instruments. The cell is applicable to services on liquid gas, and vapor streams (including steam), except for slurries, high-viscosity fluids, and some difficult chemical services. All parts in contact with fluid are Type 316 stainless steel. Total differential range is 50 to 1400 in. water. Maximum operating temperature is 350° F. The unit may be located in any vertical position relative to the orifice flange. Flow ranges are 5-1 at 50 in. water, 6-1 at 100 in., 9-1 at 150 in., and 10-1 at 200 in. and over. Fischer & Porter Co., Hatboro, Penna.

Circle No. **15** *on Reply Card*

Low-Cost Copying Machine

An office copying machine is said to be the lowest cost copying model yet devised for producing one to 100 copies in an average office. Cost of an 8½ x 11 in. copy averages under 2c, including labor, materials, depreciation, and all other charges with this new "BW Copyflex." All phases of the process take place inside the unit; it needs no inks, dark rooms, or special lighting, and has no annoying fumes. It does not require any "make ready," plumbing or exhaust fans, nor any stencil, negatives, or special training for operation. The unit operates on 110 volt, 60 cycle, A.C., and requires no special installation. Dimensions are 29½ in. wide, 28 in. deep, 50 in. high. Charles Bruning Co., Inc., 100 Reade St., New York 13, N. Y.

Circle No. **16** *on Reply Card*

For news about current new products, equipment, processes, or literature please turn to the regular "What's New!" section in this issue, beginning on page 105.

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FOR 15 YEARS Tennessee Eastman has manufactured the most effective and efficient gum-inhibiting gasoline additives known to the refining industry.

While the name, TENAMENE, is new to the industry, the products themselves are not. Formerly these inhibitors were sold through another company and under that company's name. Today these additives are available directly from the basic manufacturer.

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Tenamene 1

a gum inhibitor for motor fuels →

Specific Gravity, 75°/75°F.	0.89-0.91
Viscosity at 100°F. (Saybolt Universal)	49 secs.
Freezing Point	—27°F.
Flash Point (Tag Closed Cup)	61°F.

Tenamene 2

← *a gum inhibitor for motor fuels and aviation gasolines*

Specific Gravity, 75°/75°F.	0.94-0.95
Viscosity at 100°F. (Saybolt Universal)	63 secs.
Melting Point	>64°F.
Flash Point (Cleveland Open Cup)	285°F.

Tenamene 60

a copper deactivator →

Specific Gravity, 75°/75°F.	1.07
Viscosity at 100°F. (Saybolt Universal)	80 secs.
Freezing Point	—1°F.
Flash Point (Tag Closed Cup)	19°F.

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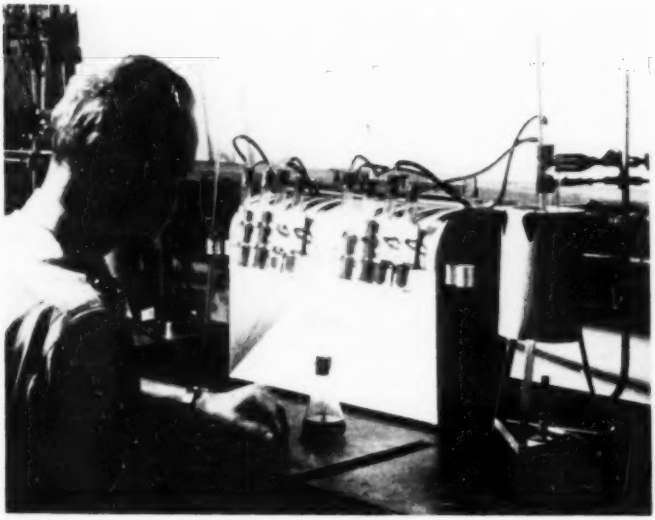
TENNESSEE EASTMAN COMPANY, *Division of Eastman Kodak Company,* KINGSPORT, TENNESSEE



TIME TO CHANGE YOUR OIL can be checked quickly by untrained personnel with this acid vapor temperature test

Tests on lube stability vs. corrosion show that

1000-Mile Oil Change Is a Must

By W. F. WEILAND

THE critical point in motor oil breakdown in actual engine use is about 1000 miles. This fact was revealed by road tests run in connection with a study of the stability of lubricating oils as related to oil corrosion.

A rapid test method, usable by untrained personnel, was developed to determine when the crankcase oil should be changed. It is based upon the fact that progressive oil breakdown can be measured by the temperature at which vapors with acid characteristics are liberated. This property is called the acid vapor temperature (AVT). The AVT of new oils may be over 300° F., that of used oils below 100° F. Incipient corrosion is noted when it drops to 215° F.

Engine wear in the past has been attributed largely to abrasion due to metal-to-metal contact or to foreign grit. Some cases of wear can be attributed to this cause. But, excluding unusual conditions, normal engine wear cannot be assigned to abrasion. It is actually corrosion wear and occurs at maximum rates in regions of maximum film pressure. Wear is therefore attributed to the formation of corrosive acid vapors in the oil.

Present day lubricating oil for internal combustion engines has many duties to perform. In addition to its properties as a lubricant, the oil must first of all keep the engine clean by retaining its own decomposition products in suspension. Secondly, the breakdown of the oil must be retarded as much as practical to delay formation of corrosive decomposition products. Thirdly, additives introduced into the oil for specific purposes should in themselves be reasonably stable, and should remain in solution or perhaps colloidal suspension. Success on the first point has been most encouraging, but answers to the second and third have not been so gratifying.

It is common knowledge that heavily loaded bearings in internal combustion engines, steam turbines, and other machinery develop pitted surfaces. This is true even though bearings have been supplied continuously with generous quantities of lubricant and there has been no failure of the lubricating system. Pitting begins in

Meet the Author

Walter F. Weiland, professor of mechanical engineering, University of Nebraska, is a native of that state and received his B.S. in M.E. from the same school in which he now teaches. Further study at the Universities of Clermont-Ferrand (France) and Pittsburgh led to an M.E. degree.

Following an association with Westinghouse Electric & Mfg. Co., Mr. Weiland taught at the University of Pittsburgh for about 11 years until 1930. Since that date he has been on the staff of Nebraska University, in Lincoln. Along with his teaching activities, he has carried on research on gasoline carburetion, oil carburetion, and some of the first extensive studies on the use of natural gas in internal combustion engines for Waukesha Motor Co.

Mr. Weiland has been in charge of the Fuels and Lubricants Laboratory at Nebraska University since 1930, during which time several new laboratory test procedures have been developed for fuels and lubricants. These include gum and soot forming properties and burning properties of fuel oils, simplified oxidation tests and acid vapor tests for lube oils, analyses of crankcase drainings, and the like.

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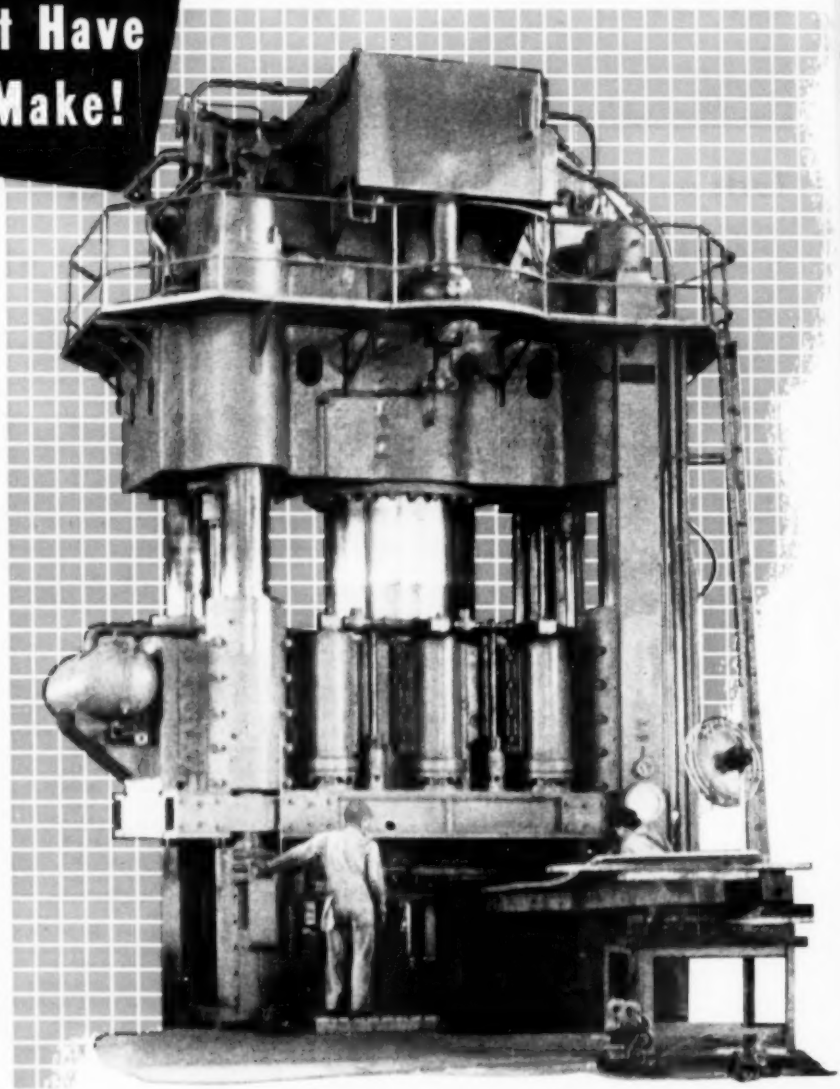

BS&B welcomes further investigation. Your inquiries will, of course, be treated in strict confidence.

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the region of maximum oil film pressure. When pitting becomes severe, complete failure by corrosion, metal-to-metal contact, abrasion heating, or a number of other causes may be expected. Initial failure must nevertheless be attributed to pitting and perhaps also to intercrystalline corrosion.

An investigation into the causes of pitting would quite logically be directed toward some possible reaction between the lubricating oil and the bearing metal. Lubricating oil degenerates under pressure as well as high temperatures.

Corrosion is frequently associated with acid conditions. A simple test for acidity in oils that have seen some use generally yields negative results. The several ASTM acid and base number tests admittedly do not establish any relation between bearing corrosion and acid or base numbers. Nevertheless, pitting and intercrystalline corrosion do occur, and may take place under conditions of flooded lubrication. Also, lubricating oils may show no acid reaction at room temperature, but very positive acid reactions at operating temperatures.

Bearing corrosion has been attributed to sulfur in gasoline, to the products of partial combustion of gasoline, and to other causes. This need not be questioned, especially under idling and light load conditions. But when bearings fail under severe loads in a matter of a few hours, the oil most certainly has been a major cause.

To establish a relation between acid, or latent acid, characteristics of the oil and bearing corrosion is much more involved than chemical tests would indicate. Even road tests which incorporate a multiplicity of conditions are of questionable value when the effect of specific variables must be evaluated. Then how is it possible to eliminate all these engine variables and still determine the oil characteristics and the effect of breakdown products on bearing metals under engine conditions?

The more important engine conditions to be considered follow:

1. Crankcase oil sump temperatures may be as high as 250° F.

2. Oil is whipped around in the crankcase as a fine mist. Under such conditions it will absorb considerable air. This air, intimately associated with the oil molecules, is available for rapid oxidation of the oil when heat is applied. See Fig. 1.

3. Oil is compressed in the oil film wedge of the bearing. The momentary temperature rise of the oil molecules passing into the region of maximum film pressure is estimated at 70° F. The total instantaneous temperature of a few molecules of oil as they pass through the thinnest part of the wedge may be well over 320° F.

4. Cylinder wall temperatures range from 350 to 500° F.

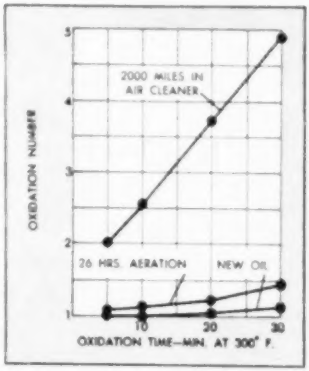

FIG. 1—Effect of entrained air on oxidation rate

5. Vapors liberated in the maximum pressure and temperature region are the result of progressive oil breakdown.

6. These vapors at the moment of formation are in their most active or nascent state; the vapors have acid-like characteristics.

7. Corrosion therefore begins in regions where these acid-like vapors are liberated.

A laboratory test which approaches these conditions would seem difficult. Too often laboratory tests are dismissed with the broad statement that they do not represent actual engine conditions. There is of course no question of the value of road tests, or of laboratory engine tests for an overall picture. But a controlled bench test may be of vital importance for answers to specific questions which help predict service performance.

Therefore, any possible correlation between acid properties in oils and bearing corrosion must be established by a study of oil behavior at conditions closely approximating engine operation, and yet eliminating other variables as far as practical. A reasonably true picture may be expected if the oil is oxidized with air at temperatures around 300° F. and in the presence of some metal such as copper, provided the condition of the oil and its effect on the copper may be measured from time to time.

The 300° F. oxidation temperature is close to that a few molecules attain for a moment as they enter the maximum pressure region of the bearing. It is not maintained very long by any one molecule, as it quickly loses heat to its neighbors on leaving the maximum pressure area. Only a few molecules are affected at any one instant, but in time in a circulating system all will have been subjected to approximately the same conditions. A laboratory test in which the entire volume of a sample is heated to a specified temperature is not necessarily more severe than actual engine conditions as far as individual molecules are concerned. The difference is simply that more molecules are involved at one time in the laboratory test. It is an accelerated test in one sense, but certainly not as far as temperature is concerned.

Laboratory oxidation with air simulates the condition in the crankcase where air is whipped into the oil, and especially if the air is bubbled through the oil in fine streams so as to contact intimately as many oil molecules as possible. The oil and air molecules in intimate contact are heated simultaneously to the operating temperature as in the engine.

It is well known that metals in contact with oil serve as catalysts to accelerate hydrocarbon breakdown. Copper is a very powerful catalyst in most instances—one reason for its use in copper strip corrosion tests. Commercially pure copper is also quite resistant to corrosion, though under some conditions it does deteriorate rapidly. Aluminum and iron also are catalysts, usually to a lesser degree than copper. The metal first accelerates oil breakdown. Then when breakdown reaches a certain point, breakdown products begin to attack the metal. Table 1 shows the effect of metallic catalysts on acid vapor temperature. In all instances copper has the greatest effect, with aluminum second and cast iron the least, except for oil No. 9.

Oil into which air has been whipped will degenerate under high pres-

Table 1—Effect of Metallic Catalysts on Acid Vapor Temperature of Lubricating Oils

(Air oxidation at 300° F. for 1 hr. with metal strips. AVT in ° F.)

Oil No.	New oil (no oxid.)	With Copper	With Aluminum	With Cast Iron
6	305	160	260	290
7	330	158	240	288
8	295	120	235	295
9	290	142	220	180

Table 2—Effect of Oxidation Time on Acid Vapor Temperature

(Air oxidation at 300° F. for conditions indicated)

Oil No.	New Oil	30 min. oxid.		3hr. oxid.	
		No metal	Copper	No metal	Copper
1	285	280	210	180	170
2	290	290	210	230	190
3	295	240	225	180	180
4	275	230	230	180	180
5	290	260	210	240	210

TYGON

Versus H_2SO_4

ONE good answer to many sulfuric acid corrosion problems is the versatile TYGON family of plastic compounds. Consisting of carefully compounded polyvinyl resins, TYGON — as a material of construction, as a medium of transmission, and as a protective coating — exhibits outstanding resistance to sulfuric acid over a wide range of concentrations and conditions.

TYGON is available in molded, calendered and extruded form, as a plastisol and as a solvent type paint. Each form is specifically suited for certain applications. Each has its limitations. All have the basic characteristics of vinyl based materials. All are backed by the "know-how" of almost 87 years experience in corrosion control.

As a material of construction, TYGON is used primarily in sheet or molded form, although extruded tape, channel, or solid cord is sometimes used. In 3/32" thick sheets TYGON is used to line tanks, drums, and hoppers; to protect fume hoods and ducts; to cover work tables and floor areas. TYGON sheets are also cut into gaskets for positive, enduring seals in all types of process equipment. TYGON sheet resists sulfuric acid, its fumes and salts, for long periods in concentrations up to 42°-55° Be acid, or equivalent, depending upon the compound used. Service temperature limit ranges from 150° to 175° F. Molded TYGON sees service as grommets, washers, gaskets, stoppers, handles, bumpers and special fittings. In these forms, TYGON resists up to 55° Be acid at temperatures ranging up to 200° F. With either sheet or molded TYGON, prolonged contact with fuming sulfuric acid, sulfuric anhydride, and mixed acids is not recommended without the counsel of U. S. Stoneware engineers.

As a piping medium, TYGON is most generally used in the form of extruded tubing. However, some short flexible couplings and other special fittings may be molded, or cast from plastisols. Lightweight, flexible TYGON Tubing, in sizes up to 2" ID, is used as temporary or permanent transfer lines, as flexible connections, as inlet and discharge ports on acid pumps, as gas lines, or as syphon hoses. TYGON Tubing resists up to 55° Be sulfuric acid at temperatures as high as 200° F. Specific temperature limits vary according to the compound used, the pressures involved and the wall thickness of the tubing. Where constant pressures of more than 40 psi are involved, braided jacket reinforcement is available and should be used. Prolonged use with fuming sulfuric acid, sulfuric anhydride, and mixed acids is not recommended without consultation.

As a paint, TYGON affords excellent protection to tanks, equipment, structural steel, walls and ceilings, against the fumes or spillage of sulfuric acid in any concentration. Temperature limit is approximately 200° F. The limitations of a thin film should be realized and contact, other than brief or intermittent, with concentrated acid, moist sulfur trioxide, and mixed acids should be avoided. For mild environments a primer and no less than two top coats should be used. For severe exposures a minimum of five coats plus primer is advised.

For a heavier duty coating, TYGON as a plastisol (TYGOFLEX) can be applied by dipping and fusing, or by spraying. TYGOFLEX is particularly suited to the application of a thick coating on intricate shapes, with or without adhesion.

In any of its forms, TYGON provides low cost protection and high degree of safety in the handling of not only sulfuric acid and related chemicals, but a wide range of other acids, alkalies, oil, greases and water. The number of forms available and the flexibility possible in mechanical, physical and chemical properties of the standard compounds permit its proper use in many applications. The versatility of TYGON is further increased by the availability of custom compounding and molding. For the best results with TYGON, consultation with U. S. Stoneware engineers is strongly urged.

TYGON plastics

In addition to TYGON in its various forms, we also manufacture a number of other materials capable of handling sulfuric acid in any concentration and under all types of operating conditions. These products include chemical stoneware and porcelain, acid proof brick and cements, homogenous lead linings, and other organic linings and coatings.

Why don't you submit your corrosion problem, today? There's no obligation and we'll be pleased to be of assistance. So write, now!

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ENGINEERS, MANUFACTURERS, ERECTORS OF CORROSION-RESISTANT EQUIPMENT SINCE 1865

sure without external heat. Preliminary tests have shown that breakdown under pressure is at least as rapid as breakdown at elevated temperature. This phase of oil breakdown has not been investigated thoroughly enough to formulate definite relations between pressure and rate of breakdown. It should be worthy of some attention in view of pressure effects in thick and thin film lubrication, and in connection with localized pressure effects due to surface roughness where metal to metal contact between high spots of a pair of mating members may occur.

A laboratory investigation on lubricating oil stability should be conducted at about 300° F., with air bubbling through the oil, and with a strip of cleaned copper placed in the oil. From this test, performance can be predicted of a lubricating oil in an engine with regard to the effect of temperature and oxidation time on the oil.[1]

Oxidation is conducted as follows[2]: (Fig. 2.) a 25 ml. sample of oil is poured into a 75 ml. test tube. A three-hole cork stopper in the test tube supports a thermometer with the bottom of the bulb about $\frac{3}{8}$ in. from the bottom of the test tube, a glass air inlet tube which extends to $\frac{1}{4}$ in. from the bottom of the test tube, and a short L-tube for connection to a vacuum pump. The test tube assembly is immersed in an oil bath to the depth of the oil in the test tube. The temperature of the oil bath is held at about 310° F., usually high enough to maintain 300° F. ±2° oil sample temperature with air bubbling through the oil. A vacuum of 4 in. water is maintained. It may be desirable to pass the air through a washing train before it enters the oil sample. Oxidation with copper is made by placing a $\frac{3}{8}$ x 8 in. copper strip polished with 00 sand paper into the oil sample.

The duration of the oxidation period will depend on the information required. It may vary from 30 min. for a copper strip corrosion test in which discoloration or deposit on the strip are sought, to 12 hr. or more if other information is desired. Change in oil color density, measured by colorimeter, gives one type of information on rate of oil breakdown. Change in acid vapor temperature gives information on vapor formation with corrosive properties and leads to determination of incipience of corrosion.

Tables 2 and 3 illustrate the changes in acid vapor temperature with oxidation prolonged up to 24 hr., with and without metallic catalysts. These tables vividly illustrate the progressive drop in acid vapor temperature even without catalysts.

Oil No. 4 in Table 2 and No. 14 in Table 3 are not adversely affected by the copper. With all the others, breakdown is more rapid with the copper. Some oils break down at a uniform rate right from the beginning; others appear to be quite stable for some time and then rather suddenly oxidize very rapidly; still others show a hyperbolic breakdown rate. All of this type of information is important for a complete evaluation of the oil.

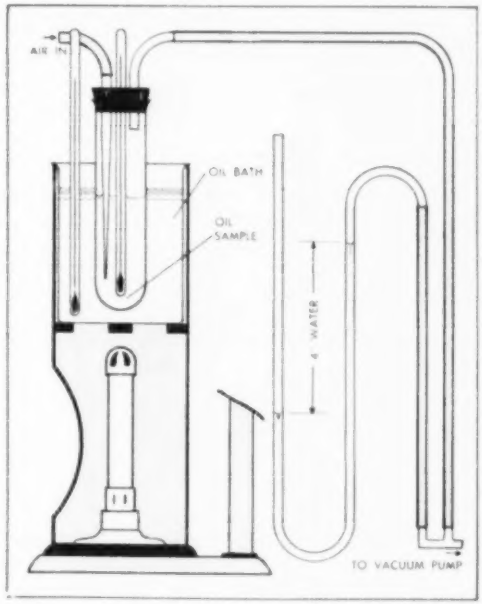

FIG. 2—Oxidation apparatus

It should be noted that change in color density of the oil is not measured with any set of color standards. Rather, the transmitted color of a column of oxidized oil is matched against a column of the new oil of the same SAE number and brand name. The ratio of the height of column of new oil to the height of column of oxidized oil is the oxidation number.

Of much more importance, however, is the determination of acid vapor temperature and the incipience of corrosion.[3] Breakdown of the oil is progressive with the step-by-step addition of oxygen by chemical combination with the hydrocarbon molecule. Alcohols, peroxides, aldehydes, fatty acids, and finally carbonic acid are formed. Corrosion troubles begin with the peroxides and become violent with the formation of the lower volatile fatty acids, most troublesome of which is formic.

As indicated above, these vapors are most active at the moment of formation. Evidence is found in that the most violent attack on the copper strip occurs at, or slightly below, the oil line, and occasionally extends slightly above. In service, pitting of bearings begins in the region of maximum film pressure.

The acid vapor temperature is easily measured by passing the vapors from the oil sample through an indicator. The apparatus is similar to the oxidation apparatus, except that the oil bath is maintained at 350° F. and the oil sample is immersed just enough so that the temperature of the sample rises 10°/min. The temperature of the oil sample at which acid vapors first make their appearance is designated as the acid vapor temperature (AVT). For new oils that have not been oxidized this ranges from 250 to 330° F. (Tables 1, 2, and 3.) The SAE number of the oil seems to have no relation to the position of the AVT in this range. Additives may or may not have an influence. No rule at present will predict or give reason for the AVT of a new oil.

As breakdown progresses AVT drops more or less rapidly to a minimum of 85-95° F. Oil filters do not improve this situation nor do any small scale reclaiming processes. A sample of oil which has seen prolonged use even in an engine equipped

Table 3—Effect of Prolonged Oxidation on Acid Vapor Temperature

(air oxidation at 300° F. for 24 hrs.)

Oil No.	No metal	With copper
10	175	140
11	155	110
12	125	95
13	170	150
14	150	120
15	105	75

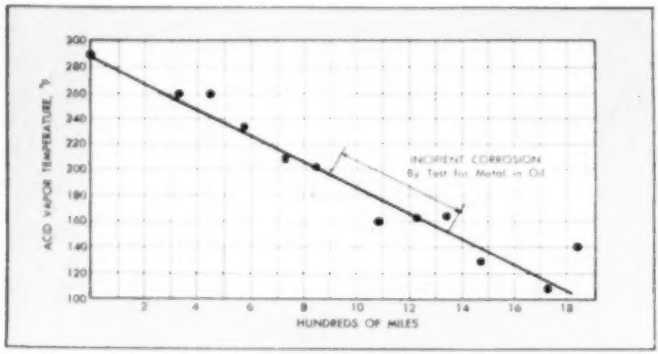

FIG. 3. Relation of Acid Vapor Temperature (AVT) to engine mileage

with an oil filter, or a sample of reclaimed oil, has yet to be found which does *not* have a low AVT. It will be shown later that an AVT of 215° F. is the danger signal.

It must be clearly understood that the acid vapor temperature does not necessarily indicate the presence of free acids in the oil. Tests on many crankcase drainings have often failed to show the presence of free acids, but nevertheless show very low AVT. Free acids in themselves may be essentially harmless and may not come in contact directly with bearing surfaces, as an oil film on the surface prevents contact unless the acids are in considerable abundance.

However, the film will break down under heat and pressure and develop vapors of the lower organic acids. Because they are in the film in contact with the metal surface, these acids certainly come into direct contact with the metal. Because they are most active at the moment of formation their effect is magnified.

But once they leave the region like the free acids they too emulsify with the oil and are no longer of major concern. Crankcase ventilation may remove the newly formed acids or remnants thereof, but damage has already been done to the engine. In fact constant and vigorous ventilation may aggravate the acid formation because of the continuous introduction of new air.

Formation of lower organic acids during oil breakdown is particularly annoying because the acid boiling points fall within the bearing and ring belt temperature ranges. The boiling point of formic acids is 213° F., while next in order are those which are the result of breakdown of organic compounds above methane. Other organic acids with their respective boiling points are acetic—277° F., propionic—286° F., and butyric—326° F. In addition, complexes of these organic acids together with carbonic acid with vaporization temperatures of 100° F. or less may not only be expected, but most certainly do appear. An example might be methyl formate with a boiling point of 89° F. When AVT has reached the danger point it is a warning that the oil has reached the end of its useful life.

The question now arises: "What happens to a lubricating oil under actual service conditions?" Table 4 lists a miscellaneous assortment of crankcase drainings from different engines operated under various conditions from 500 to 1900 miles between oil changes. No data is presented on the actual operating conditions, nor on the engine conditions. Actual operating and engine conditions undoubtedly have some bearing on oil breakdown, but further discussion of these influences is outside the scope of this article.

It is noted that oil No. 20 is approaching the danger point at 900 miles in one engine and is still slightly above the danger point in another engine at 1000 miles. Oil No. 18 is already far within the danger region at 500 miles, while oil No. 17 is above at 1500 miles in one engine, and well into the danger zone at 1900 miles in another. This table does not attempt to evaluate the several lubricating oils because of the multiplicity of operating conditions. It does, however, show that oil changes should be made at 500 to 1500 miles.

These results indicate the necessity of controlled studies on the condition of lubricating oil in terms of miles of operation. Such an investigation has been undertaken on a number of vehicles. The results of one of these studies is shown in Fig. 3. The black dots show results of tests on a milk pick-up truck which travels approximately 100 miles per day over the same route. A 25 ml. sample of oil was taken each day from the crankcase immediately after the truck returned from its trip and before the oil had settled. In this manner a fairly representative sample was obtained. The triangles are the results of a similar test several months later when the accumulated mileage was near 30,000. The oil was changed regularly in this engine at about 1600 miles. The truck was always operated by the same driver and the same oil was used throughout. Most significant is the close correlation of the curve for the new engine and for the same engine after 30,000 miles.

Table 4—Acid Vapor Temperature of Crankcase Drainings

Oil No.	Miles	AVT ° F.
16	900	150
16	1000	120
17	1500	270
17	1900	180
18	500	145
19	800	150
20	900	230
20	1000	220

It now will be of interest to relate AVT to metal corrosion. Four possible procedures are suggested: namely (1) determination of weight loss of metal strips in the oil during prolonged oxidation, (2) metallographic examination of metal strips for incipient etch during prolonged oxidation, (3) copper strip corrosion tests at temperatures from 122 to 300° F., and (4) micro-analysis for metals which may have passed into the oil as a solution or a colloidal suspension during oxidation.

(1) Gravimetric tests[4] are open to a variety of errors, principal of which is the necessity for prolonged oxidation periods to determine a measurable weight loss of the metal. During such a prolonged period the oil has passed far beyond the danger point in its breakdown and therefore the incipience of corrosion is impossible to determine. Some overall results can be obtained but their value is questionable.

In a series of tests, the weight losses were definitely positive but the oil had far exceeded the danger point. Shorter oxidation periods are of no value because the first stage in a corrosion process is the formation of a metallic oxide which clings more or less rigidly to the metal, causing an actual increase in weight of the test strip. Oil is absorbed by the metal, and oil gums, varnish and carbon are deposited on the metal surface, each of which are difficult to remove, and will affect the weight of the test strips.

The usual solvents and even concentrated hydrochloric acid will remove some of these deposits, but complete removal is always uncertain.

(2) Metallographic studies[5] to determine incipient corrosion have met with a little more success. The surface of the specimen must be carefully prepared to produce a finish suitable for microscopic examination. Special skill must be developed to be able to note incipient etch and pitting, which may be very difficult to distinguish from gum and varnish

deposits. An approximate relation has been established by this method between AVT and incipient corrosion. Table 5 shows the AVT at the end of a series of oxidation periods with copper and aluminum. Corrosion seems to begin in both metals at an AVT just below 200° F. and between four and six hours oxidation. This method has also been abandoned because of the special techniques involved.

(3) Copper strip corrosion tests at temperatures which range from 122 to 300°F. give an indication of the formation of oxides or sulfides on the copper. These tests are rapid and easy to make but require some skill for interpretation of results.

It has been shown[6] that the thickness of the oxide film on copper strips, a measure of the amount of oxidation, can be approximated by the film's color.

(4) The fourth method, and the one which appears to give the most positive results, is a micro-chemical analysis of the oil for incipient traces of copper after short oxidation periods with a strip of copper. Small traces of copper are readily determined with a number of organic reagents, provided first that the copper can be completely and effectively removed from the oil.

Copper or other metals taken up by the oil appear to exist either in colloidal suspension, or as metallic formates, acetates, etc.[6] The actual state of the metal or its compound in the oil is immaterial, except that if in finely divided particles it may partially settle in the crankcase sludge. If an analysis of drainings is made it is important to mix the sediment thoroughly with the oil. Copper may be determined qualitatively, or with colorimetric titration very precise quantitative results may be obtained.

The present investigations have established a positive relation between incipient corrosion and AVT. Hence quantitative determinations have not been considered essential. In the final analysis, successive quantitative determinations might determine a rate of disintegration of the metal. But as oil breakdown is progressive with time and does not reach a state of stability, quantitative determinations assume minor importance. To establish the point of incipient corrosion becomes, after all, of major consequence. Hence, oxidation of the oil at 300°F. in the presence of a metal catalyst, and a test for incipient corrosion and AVT at stated intervals will give the required positive results. Oils may then be classified on the basis of the oxidation time which will lower the AVT to the danger point.

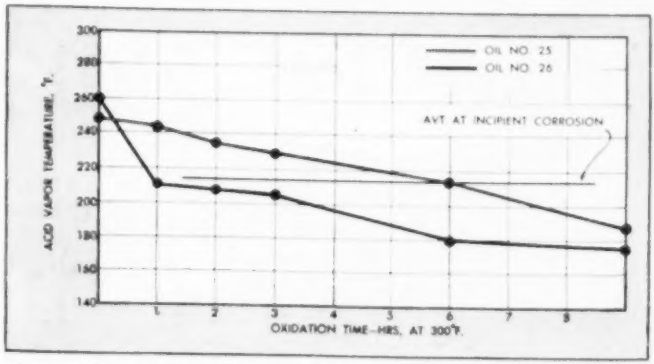

FIG 4—Relation of Acid Vapor Temperature (AVT) to incipient corrosion

Determination of incipient corrosion is a scientific laboratory procedure of principal value for research, and would be discouraged as a routine control test.

Incipient corrosion is definitely related to an AVT of 215° F. (Fig. 4), and the AVT test, when suitable apparatus is once set up, becomes a simple routine that can be performed by an embryo technician. Therefore the AVT test can be performed in the laboratory or shop of any fleet operator or it can be set up in service stations to check the condition of the oil in the crankcase and determine in a matter of minutes whether or not the oil should be changed.

Fig. 4 shows the relation between oxidation time, AVT, and incipient corrosion for two well known detergent-type lubricating oils. Oxidation was at 300° F. with air agitation and with a strip of cleaned copper in the oil. Incipient corrosion is defined as the first indication of copper in the lubricating oil sample as determined by micro-analysis.

Oil No. 25 shows a definite indication of copper at the end of 6 hr. oxidation when AVT has dropped to 215° F. Oil No. 26, containing a polarizing additive, begins to corrode almost immediately. At the end of 1 hr. the AVT has already dropped to 215° F. In both oils, test for copper became progressively stronger as oxidation was prolonged.

Test temperatures as low as 220° F. will, if immersion is sufficiently prolonged, cause the metal to pass into the oil. (Table 6.) These tests were run for a period of one week at 220° F. without air agitation and in lightly stoppered test tubes. The oils, all well-known, are arranged in descending order of estimated amounts of copper precipitate. The two oils illustrated in Fig. 4 are in the upper bracket in this table. Of the ten standard brands, only two show little or no tendency to dissolve the metal. These last two may be classed as highly desirable for their non-corrosive characteristics. Also, oil No. 26 does not show up quite as badly in the 220° F. test as it does in the 300° F. oxidation of Fig. 4, while oil No. 25 is undesirable at 220° F.

It is not intended to discuss various commercial products sold for addition to lubricating oils. But it may be stated that some of these "engine cleaning compounds" or "friction reducing compounds" have been shown to be violently corrosive. This is true even at room temperature, either as concentrated additive or diluted in the oil as per manufacturer's recommendations.

Note: Acknowledgement is made to the University of Nebraska Research Council for partial support of this investigation.

Table 5 — Acid Vapor Temperatures and Incipient Corrosion — Metallographic Method

Oxid. Time	No Metal	With Copper	With Aluminum
0	270	—	—
2 hr.	240	195	200
4 hr.	225	190	195*
6 hr.	205	175	185
12 hr.	200	170	180
24 hr.	200	160	150

* Incipient corrosion.

Table 6—Oil Corrosion at 220° F., One Week Exposure in Closed Tubes. No Air Agitation

Oil No.	Degree of Corrosion
25	Maximum
32	Maximum
27	Very heavy
26	Very heavy
28	Very heavy
29	Heavy
30	Medium
31	Medium
33	Light
34	Very light

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(3) W. F. Welland, "The Mechanism of Lubricating Oil Breakdown and its Relation to Oil Corrosion," *Scientific Monthly*, Aug. 1950.

(4) G. R. Miller, "Corrosion of Metals Due to Lubricating Oil," Thesis 1940, University Nebraska Library.

(5) L. C. Johnson, "A Metallographic Study of the Progress of Oil Corrosion," Thesis 1942, University Nebraska Library.

(6) U. R. Evans, "Metallic Corrosion, Passivity and Protection."

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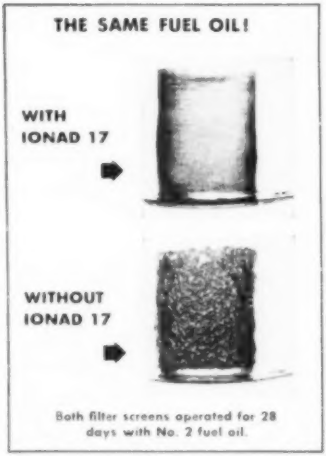

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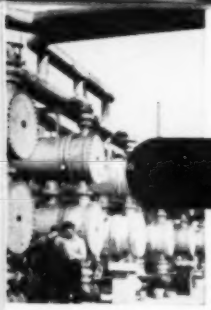
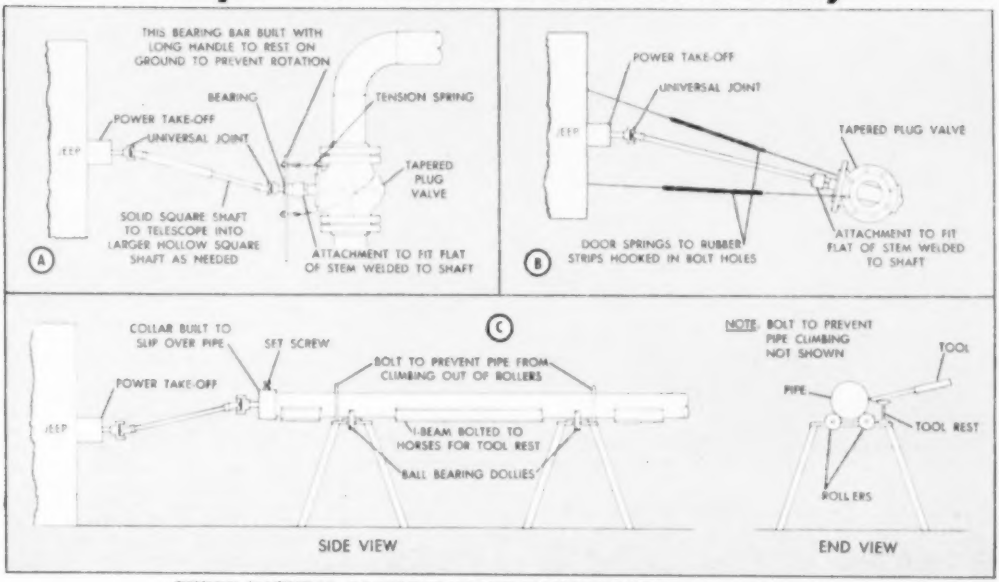


PLANT PRACTICES

Practical Tips and Ideas for Improving Operations

Jeeps Do Three Jobs in a Jiffy



THREE NATURAL GASOLINE PLANT MAINTENANCE operations handled more efficiently and easily by using a jeep

THAT famous "jack-of-all-trades" for the armed forces, the jeep, has been found equally valuable by industry in general. But it took some ingenious field maintenance men in the natural gasoline industry to put the jeep to work as a maintenance "tool."

Out in Oklahoma, the Panoma Corp. is using jeeps—and tractors if no jeeps are around—to do plug valve grinding in the field or in the shop and to clean and paint used pipe. Jeeps provide power through a take-off and universal joints, as shown in the accompanying sketch.

Field valve grinding is illustrated at *A*. A connection is made between the universal joints by a flexible shaft or a telescoping shaft (can be made of two pieces of square stock, one small enough to slide inside the other). The telescoping shaft is especially adapted to meter run valves. The flexible shaft is required for valves in boxes and deep under ground.

At the valve end, a fitting is attached to the universal that will fit the flat on the valve stem. Using conventional grinding compound between plug and seat, the operation is performed by rotating in reverse and in low gears at about one minute intervals.

Proper tension is obtained with the bar and tension spring arrangement shown in the sketch. The bar is 2 x ¼ x 36 in., with two small holes about 12 in. apart (one at the end of the bar), and a hole centered between them, large enough to fit the shaft. Wire hooks in these smaller holes are attached to the ends of a spring—or inner tube rubber—long enough to reach around the valve body. The longer end of the bar rests on the ground to prevent rotation.

Shop valve grinding is shown at *B*. Essentially the same technique is employed as in the field operation, except that the tension spring is attached directly to the jeep because the connecting shaft is not the telescoping or flexible type. The shaft preferably is about 3 ft. long and made of 1-in. pipe or ¾-in. rod. No brace is required to keep the valve body from turning on the floor if the grinding compound is kept in the core and proper tension is maintained, but a jig can be easily rigged up as safety factor.

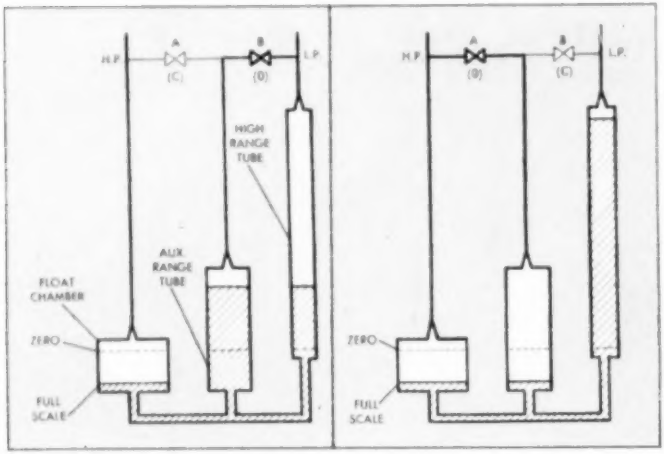
Reclaiming used pipe is done by the equipment shown at *C*. In this case the jeep is used as a power drive for rotating the pipe which rests on rollers. The rolling dollies each consist of two large ball bearings, each welded to a heavy steel plate, ⅜ x 18 x 8 in. The plates are welded on horses made of 2-in. pipe about 24 in. high. The horses are placed about 15 ft. apart and tied together by welding a 3-in. I-Beam on top of the dolly plates so that its top is about 2 in. away from the pipe on the rollers. The beam should be at least 25 ft. long. Long bolts inserted vertically into holes in the

The above item is based on three prize-winning ideas from the "Operating Kinks" session at the Panhandle-Plains regional meeting of the Natural Gasoline Assn. of America, Amarillo, Texas, Nov. 29, 1951, and submitted by W. R. Bowen, field foreman, Panoma Corp., Guymon, Okla.

dolly plates and on the side toward which the pipe will roll will prevent the pipe from climbing out of the rollers.

Cleaning tools—files, wire brushes, cutter knives, etc.—are held against the I-Beam as a tool rest. Proper speed of rotation can best be determined by experience. After cleaning, the pipe can be painted on the same rollers by reducing the rate of rotation.

How to Increase Flowmeter Range



DUAL RANGE FLOWMETER. mercury type; low range at left, high at right

By E. D. MATTIX and R. W. GROENDYCKE

THE mercury differential type flow meter in its standard simple form, with cylindrical mercury chambers and square root flow scale is limited in usefulness where there are wide changes in the rate of flow. The rangeability or ratio for reasonably accurate flow readings is about 3:1.

Innumerable flow measurement and control applications exist where the maximum rates may be six or more times as great as the minimum flows. A few examples are: seasonal changes in heating steam load; variations in feed and product rates on a refining process due to fluctuations in supply, demand, and compositions; variations in solvent feed ratio requirements with changes in types of charging stock.

Several flow meter designs and arrangements are available for improvement of the rangeability of the conventional square root flow scale. Dual range meters of a somewhat novel design using an auxiliary range tube have been used successfully on several applications at the Cities Service Refining Corp. refinery at Lake Charles, La. While no claim is made that it is a cure-all design, it does have certain talking points and may be found quite useful in other plants.

The accompanying sketch indicates the arrangement of the mercury chambers, U-tubes, and valve manifolds, and shows the mercury levels under various conditions. The standard float chamber is on the high pressure, or upstream, side of the orifice in this example. The auxiliary range tube is in the center, and the so-called high range tube is at the right.

On low range service, valve *A* is closed and valve *B* is open, to place the two range tubes in parallel, both on the low pressure, or downstream, side of the orifice. The mercury levels will rise simultaneously in these two tubes as the differential pressure increases. We have here the equivalent of one large diameter range tube.

For high range service, valve *B* is

The preceding article is based on information contained in a paper, "Refinery Control Problems," presented by Mr. Mattix at the Instrument Conference, Houston, Texas, Sept. 10-14, 1951. Mr. Mattix is technical assistant to the operating superintendent and Mr. Groendycke is technical assistant to the chief engineer, Cities Service Refining Corp., Lake Charles, La.

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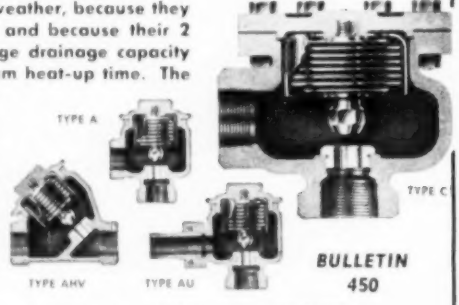

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closed and valve *A* is opened, to place the auxiliary tube in parallel with the float chamber. With an increase in differential pressure the mercury levels fall simultaneously in the float and auxiliary chambers and rise only in the right hand, or high-range tube. We then have the equivalent of a large diameter float chamber and a relatively small diameter range tube.

With this design it is possible to change from low to high range, or vice versa, by manipulating valves A and B without zeroing the meter. On a sealed meter, however, it is particularly desirable first to equalize and zero the meter in the conventional manner. Otherwise, some loss of sealing liquid and unbalance of the seals would take place after repeated range-changing.

Dual range flow meters are now available from several manufacturers, usually in flow range ratios of 2-1. Flow range ratios of 3-1 would be more desirable.

For those who find a need to build their own dual range meters, the diameters of the auxiliary and high range chambers can be calculated easily from formulas which have been derived from simultaneous algebraic equations. The known conditions to be substituted in the formulas are the desired high and low differential ranges expressed in inches water, dry calibration, and the float chamber diameter and float travel for full scale deflection.

Two Ideas for Operating Heat Exchangers in Winter

TWO "tricks" worked out by personnel of the East St. Louis, Ill., refinery of Socony-Vacuum Oil Co., Inc., have overcome problems encountered in cold weather operation of heat exchange equipment.

One relates to shell-and-tube exchangers. In winter it may become desirable to deliver certain streams to storage or blending, for example, at a higher temperature than may have been considered in the original design. At the same time, cooling water is of course much colder than it normally is at other seasons.

The most obvious solution is to cut back on the flow of the cooling water. But in actual practice, this might be great enough so that only a small trickle of water is used. That is not only difficult to regulate but also may invite freeze-ups of the coolant. The final solution was to cool only a portion of the hot oil stream, by-passing the rest. When the two streams unite on the other side of the exchanger, the combined stream is at the desired temperature. Meanwhile, a large flow of cooling water can be maintained through the exchanger, eliminating any possibility of a freeze-up.

The same scheme in reverse can be applied to a coil-in-box cooler by installing several pipe drains at one or two levels below the main overflow. This exposes the top layers of coils, with practically the same effect as by-passing them. The water flow to the box may be reduced just enough to not rise above the level of the particular drain being used.

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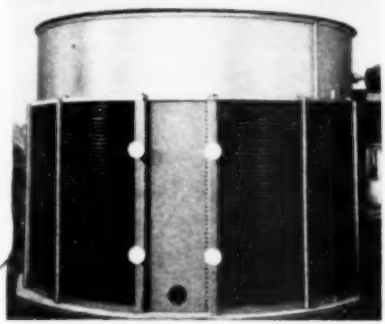

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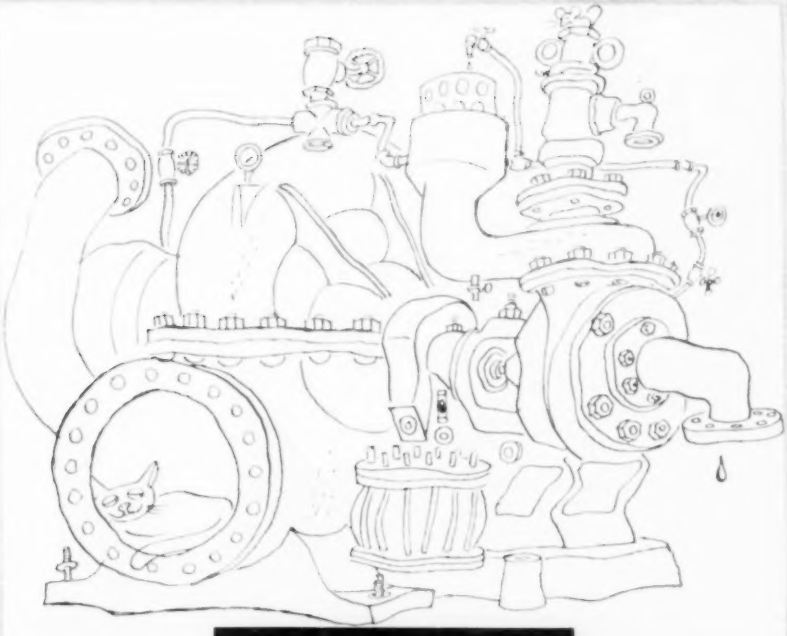

PICTURE OF A "*Refinery Pump*"

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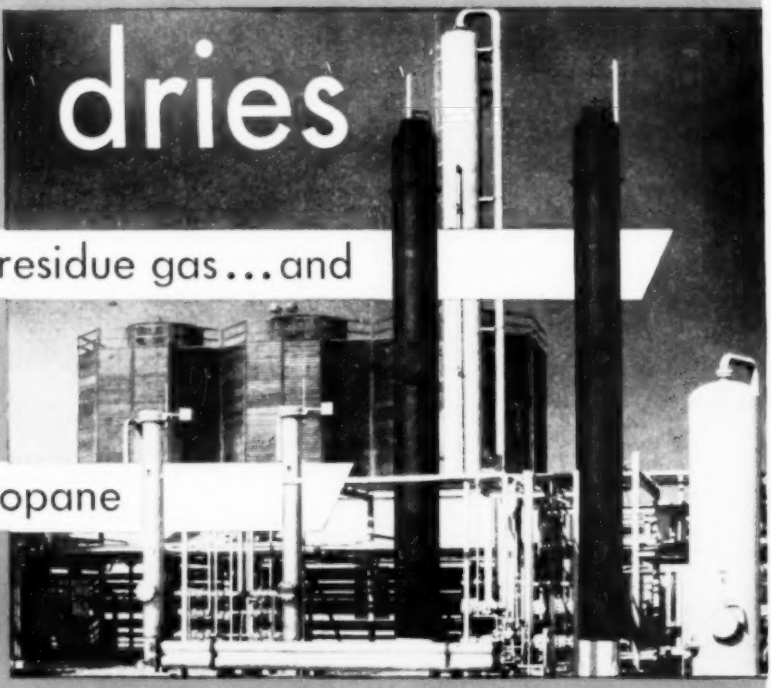

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ALUMINAS and FLUORIDES

How to Test Treating Unit Wastes

By W. J. HOGAN and G. E. MAPSTONE*

AFTER gasoline has been treated with concentrated sulfuric acid it is normally subjected to a water wash and finally a caustic wash to remove the last traces of acid. Some of the acids removed are organic derivatives of sulfuric acid such as aryl sulfonic acids from the sulfonation of aromatics, and alkyl sulfuric acids from the sulfation or esterification of olefins.

Since these acids possess surface active properties, it is frequently necessary to determine the amount present in waste wash waters and other effluents as a preliminary to their disposal in the refinery. The method of Barr et al.[1] for the determination of ionic surface active agents was studied and found to be applicable to the analysis of the waste acid wash water and the neutralization caustic wash. It has given satisfactory results.

Reagents used in the analysis are as follows:

1—Bromphenol blue: dissolve 0.4 gm. of the solid indicator in 200 ml. of alcohol and make up to one liter with distilled water.

2—Chloroform.

3—Cetyl pyridinium bromide, 0.001N: dissolve 0.388 gm. of the solid in one liter of distilled water.

Reagent is standardized as follows: The cetyl pyridinium bromide may be standardized against potassium palmitate or the salt of any other convenient, high molecular weight acid which has surface active properties in solution. Using palmitic acid, the acidity is first determined by ASTM D974-48T or I. P. (Institute of Petroleum) 1.46 as a check on its purity. An 0.001N solution is then prepared by dissolving the calculated amount of the acid in methyl alcohol, titrating with 0.1N potassium hydroxide solution until just alkaline to phenolphthalein, diluting to 300 ml. with the methanol, and then making up to 500 ml. with 50:50 water-methanol. This standard palmitate solution is used to standardize the cetyl pyridinium bromide solution by the method outlined below.

Barr reported[1] that the ratio of cetyl pyridinium bromide to the organic acid was not stoichiometric though it was approximately so. However, by standardizing the reagent against palmitic acid or some other suitable high molecular weight acid, it is considered that the determination of the organic sulfur acids should be sufficiently accurate for any of the purposes for which they may be required.

Analysis procedure: Pipette into a large test tube or a small bottle, 5 to 20 ml. of the wash water, and add sufficient caustic soda solution to render it just alkaline. Alternatively, use a 5.0 ml. aliquot of neutralization caustic (5.0 ml. diluted to 500 ml. with distilled water). Add 5 drops of bromphenol blue solution and 15 ml. of chloroform and shake well. Titrate the mixture with standard (0.001N) cetyl pyridinium bromide, shaking vigorously after each addition, then allowing to stand for approximately one minute to permit the phases to separate. At the end point the blue color is just transferred from the water into the chloroform. A blank titration is carried out on 5 ml. of distilled water.

The best procedure was to carry out a preliminary titration by adding the cetyl pyridinium bromide in increments of 1 ml. until the blue color was discharged into the chloroform. An accurate titration was then made in which increments of 0.1 ml. or less were added as the end point was approached. In the initial stages of the titration, the anion active compounds present caused emulsification of the chloroform, which masked the blue color of the indicator. As the titration proceeded, however, the emulsion became less stable and, at the end point, separation was faster and color readily observed.

As the appearance of the color in the chloroform layer is due to the presence of the cation active agent complex, a slight excess of the agent was necessary, the amount required being readily determined by making a blank titration omitting only the sample.

Comments on the procedure: Bromphenol blue, being an acid dyestuff, forms a cation active solution. As the appearance of the blue color in the chloroform layer is due to the presence of a complex of this with the cetyl pyridinium bromide, a slight excess of this reagent must be present at the end point. This is determined separately by carrying out a blank determination omitting only the sample.

Since the average molecular weight of the organic acids from gasoline treating wastes will most probably be unknown, the results may be reported either as normalities or, perhaps more conveniently, as the equivalent of some individual acid of approximately the average molecular weight; for example, sodium octyl sulfate for gasoline wastes, or as palmitic acid.

Results may be calculated in various ways, the most convenient being shown in Table 1.

The authors wish to acknowledge with thanks the permission granted by the management of National Oil Pty. Ltd. for the publication of this paper.

References

(1) Barr, T., Oliver, J., and Stubbings, W. V., *J. Soc. Chem. Ind.*, Vol. 45, No. 67 (1948).

Table 1—Calculation of Results in Surface Active Agent Test

Concentration expressed as:	In wash waters	In neut. caustic
Normality	$\frac{N(V^1 - B)}{V}$	$\frac{N_F(V^1 - B)}{V_F}$
Sodium octyl sulfate:		
grams per liter	$\frac{232\,N(V^1 - B)}{V}$	$\frac{232\,N_F(V^1 - B)}{V_F}$
lbs. per gal. (U. S.)	$\frac{1.93\,N(V^1 - B)}{V}$	$\frac{1.93\,N_F(V^1 - B)}{V_F}$
Palmitic acid:		
grams per liter	$\frac{256\,N(V^1 - B)}{V}$	$\frac{256\,N_F(V^1 - B)}{V_F}$
lbs. per gal. (U. S.)	$\frac{2.13\,N(V^1 - B)}{V}$	$\frac{2.13\,N_F(V^1 - B)}{V_F}$

Where: N = normality of standardized cetyl pyridinium bromide solution.
V^1 = ml. cetyl pyridinium bromide solution required for titration.
B = ml. required for blank titration.
V = ml. solution titrated (usually 5 ml.)
s = ml. caustic solution diluted prior to test.
s^1 = ml. (usually 5 ml. to 500 ml.)

* Messrs. Hogan and Mapstone were associated with National Oil Pty. Ltd., Kurnell, New South Wales, Australia, at the time this article was prepared. Their present addresses are: Mr. Hogan: P. O. Box 5000, Queensland. Mr. Mapstone: C.S.I.R.O. Fuel Research Station, P.O. Box 3, Chatswood, New South Wales.

From refining through distribution...

DU PONT METAL DEACTIVATOR COUNTERACTS COPPER CONTAMINATION IN GASOLINE

ANTIOXIDANT Type	ANTIOXIDANT Lbs/1000 bbl.	DU PONT METAL DEACTIVATOR Lbs/1000 bbl.	A.S.T.M. Ind. Per. Minutes	STORAGE RESULTS 10 mg. gum, days
Du Pont No. 5	7.5	0	277	65
Du Pont No. 5	7.5	1.0	460	225
Du Pont No. 5	2	0	404	42
Du Pont No. 5	2	1.0	406	194

IN TWO TYPICAL GASOLINES, Du Pont Metal Deactivator increased storage stability by 246% and 362% respectively. Note that in the first gasoline (top), ASTM tests showed the need for Metal Deactivator, while only the storage test gave an accurate indication of this need with the second gasoline. This is one of the reasons why storage tests are recommended over accelerated tests by the Du Pont Petroleum Laboratory.

With the consumer highly interested in quality, at-the-pump gasoline stability is an important competitive factor in service station sales.

Yet, out of 33 typical service station samples recently tested by the DuPont Petroleum Laboratory, *more than 30%* were found to contain copper.

Some of these contaminated gasolines had not been copper sweetened and may not have contained copper when they left the refinery. But since distribution systems contain valves, pumps and various fittings which can be a potential source of this metal, the gasolines, as a result, may become contaminated.

DU PONT METAL DEACTIVATOR is specially formulated to offset the harmful effects of copper in gasoline. And, when copper is present, the desired stability can generally be obtained *more economically* by adding small amounts of Du Pont Metal Deactivator, than with antioxidants alone.

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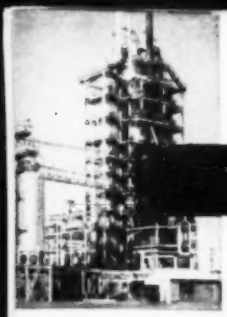

PROCESSING PATENTS

New Developments in Processes and Products

By PETER J. GAYLOR, Patent Attorney
Gaylor, Citelli & Jurick, Newark, N. J.

Partial Removal of Methanol Promotes Regeneration of Spent Caustic Solution

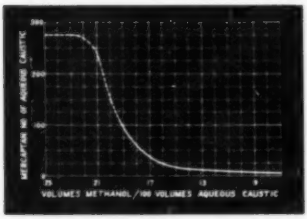

FIG. 1—Solubility of mercaptans in caustic-methanol solutions (Standard Oil Co.—Ind., U. S. 2,560,178)

ONE improvement in spent caustic-methanol recovery, as outlined by Standard Oil Co. (Ind.) in its U. S. patent 2,560,178, depends on the discovery that when one-third or more of the methanol from the spent caustic potash is distilled off at relatively low temperature, most of the mercaptides remaining in the caustic concentrate in a top liquid layer, which layer may be skimmed off, leaving the caustic in suitable condition for recycling. This is particularly important in the case of sweetening heavier oils such as kerosene distillates, which contain correspondingly heavier mercaptans.

The usual method of regenerating spent caustic by removing the mercaptans by steaming at elevated temperature requires much larger amounts of steam in the case of the heavier mercaptans, thereby increasing the cost of the operation. Also, high regeneration temperatures cannot be used because the mercaptans decompose in presence of caustic, forming alkali metal sulfides that are troublesome to handle and represent a loss of caustic from the process. Furthermore, higher temperatures increase corrosion problems and also necessitate cooling to keep down the mercaptan re-entry value limits which determine the extent to which mercaptans will be removed from the sour oil.

It is generally desirable to reduce mercaptan content of the kerosene or heater oil to preferably about 1-5 mercaptan number. Extraction of mercaptans from such oils is best effected by employing around 60 volumes of methanol per 100 volumes of aqueous caustic (preferably potassium hydroxide of 50-65% concentration). The presence of 2-20% of alkyl phenol solutizer also aids greatly in the mercaptan removal operation.

After extraction of the oil with this reagent, most of the methanol can be recovered by distillation at reduced pressure (10-100 mm. of mercury, absolute) at about 130°-180° F, reducing the methanol content in the caustic to below 15 volumes per 100 volumes of caustic solution. When highly concentrated solutions of potassium hydroxide are employed, the removal of at least one-third of the methanol from the caustic causes the dissolved mercaptides to separate from the solution as a top layer, leaving the caustic potash suitable for recycling. This is apparent from Figure 1 which shows the mercaptan number of the caustic solution in which different concentrations of methanol are employed. At a concentration of about 15 volumes of methanol in concentrated caustic containing 59 parts KOH and 41 parts by weight of water, the amount of mercaptan present is very low.

Treatment with Glycerine Reduces Ash in Residuals

IN REFINERY practice, it is customary to treat reduced crude with caustic soda, prior to removing lubricating oil fractions by vacuum distillation. Such an operation converts any naphthenic acids present into alkali naphthenate soaps that remain in the residuum in admixture with high boiling hydrocarbons and asphaltic material. This residuum product will therefore have a high ash or inorganic content which reduces its value for use as fuel oil. Naphthenic base residuums generally have an ash of 2-3%, whereas, if they are to be used as fuel oil, the ash content should be less than 0.3%, and preferably below 0.1%.

Removal of the ash components is difficult due to the fact that residual oils have a great emulsion-forming tendency after neutralization of the naphthenic acids.

In its U.S. patent 2,545,806, Sun Oil Co. discloses that residuums can be de-ashed effectively by first mixing the oil with a small amount of glycerin (0.1-2% by volume), then neutralizing the alkaline naphthenates with concentrated (66°Be) sulfuric acid and vaporizing the water from the mixture. The glycerin causes the inorganic salt, after removal of the water, to have a large crystal size, so that it can be easily separated from the oil by settling, filtering, etc.

In one example given, a neutralized naphthenic base residuum having the following properties:

Saybolt furol vis. at 210° F.	406
API gravity	19
Sulfated ash content, %	2.99

was first mixed with 1% glycerin (by volume), and the mixture was treated at 250°F. with sufficient 66 Be sulfuric acid to neutralize the residuum. Water was permitted to evaporate and the dehydrated mixture was settled for one hour at about 250°F. The oil layer was found to have a sulfated ash content of only 0.05%, so that about 98% of the ash content was removed with only one hour settling. Treatment of the stock in the same manner but without the addition of glycerin resulted in no appreciable removal of salt even after permitting the neutralized residuum to stand overnight.

Patents Issued in November

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for November 6, 13, 20, and 27, Vol. 652, Nos. 1-4.

Chemicals

2,573,674 (Standard Oil Co. (Ind.)) method of halide manufacture.

2,573,675 (Universal Oil Products Co.) Process for the sulfonation of alkyl aromatic hydrocarbons.

2,573,710 (M. W. Kellogg Co.) Process of oil-fishing shales.

2,573,751 (Matheson Chemical Corp.) Oxidation of petroleum hydrocarbons in presence of chlorine dioxide.

2,573,796 (Sinclair Refining Co.) Production of calcium sulfonate solutions.

2,573,947 (Shell Development Co.) Preparation of alkyl hydroperoxide compounds.

2,574,020 (Phillips Petroleum Co.) Alkylation of an aromatic hydrocarbon with an olefin, polymerization reaction with alkyl poly sulfide.

2,574,225 (Compagnie Francaise de Raffinage) Manufacture of alcohols from olefins.

2,574,444 (Shell Development Co.) Substituted aryl tetrahydrofurfuryl ethers.

2,574,452 (Phillips Petroleum Co.) Manufacture of alkyl sulfonyl trihalomethanes.

2,574,466 (Phillips Petroleum Co.) Hydrocarbon conversion of acetylenic hydrocarbons.

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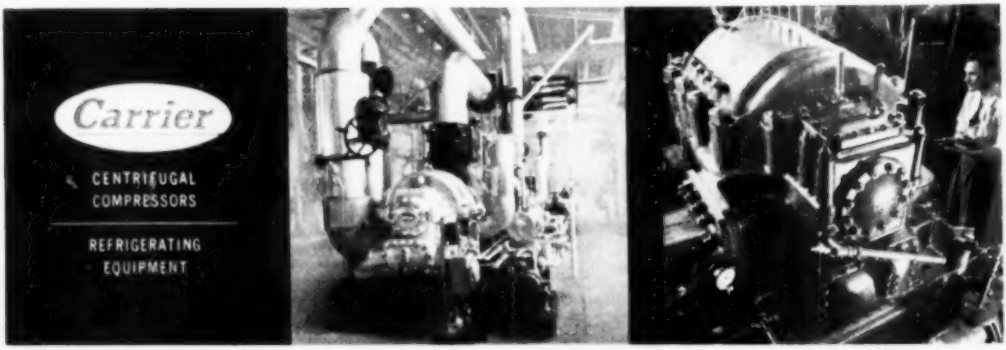

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MERCANTILE SECURITIES BLDG., DALLAS 1, TEXAS

2,574,815 (Anglo-Iranian Oil Co. Ltd.) Catalytic desulfurization of kerosene and white spirits.

2,574,816 (Anglo-Iranian Oil Co. Ltd.) Catalytic desulfurization of gas oil-naphtha mixtures.

2,574,817 (Anglo-Iranian Oil Co. Ltd.) Catalytic desulfurization of petroleum hydrocarbons.

2,574,818 (Anglo-Iranian Oil Co. Ltd.) Catalytic desulfurization of gas oil.

2,574,819 (Anglo-Iranian Oil Co. Ltd.) Process of catalytic desulfurization of naphthenic petroleum hydrocarbons followed by catalytic cracking.

2,574,820 (Anglo-Iranian Oil Co. Ltd.) Desulfurization of sulfuretted extracts.

2,574,821 (Anglo-Iranian Oil Co. Ltd.) Catalytic desulfurization of petroleum hydrocarbons.

2,574,525 (The Pure Oil Co.) Regeneration of spent alkali using antifoaming oxidation promoter.

2,574,526 & S (Petrolite Corp. Ltd.) Process for breaking petroleum emulsions using certain hydroaromatic analogues of certain hydrophile hydroxylated synthetic products.

2,574,541-3 (Petrolite Corp. Ltd.) Process for breaking petroleum emulsions.

2,575,519-20 (Union Oil Co.) Adsorption processes.

Re 23,432 (Petrolite Corp. Ltd.) Process for breaking petroleum emulsions.

2,576,092 (Koppers Co. Inc.) Purification of coke oven benzene.

2,576,525 (Sun Oil Co.) Process for separating hydrocarbons fractions containing aromatics.

2,576,588 (Standard Oil Co.) Treating sulfonic & alkane sulfonic acid.

Hydrocarbon Synthesis

2,573,795 (Phillips Petroleum Co.) Hydrocarbon synthesis process.

2,574,902 (United States of America) Method of oxidizing aqueous organic chemical wastes using the Fischer-Tropsch process.

2,576,297 (Standard Oil Development Co.) Process and apparatus for contacting fluid solids with gases in hydrogenation of carbon monoxide.

Re 23,431 (Standard Oil Co.) Recovery of oxygenated compounds and hydrocarbons from mixtures thereof.

2,576,598 (The M. W. Kellogg Co.) Synthesis of organic compounds by hydrogenation of carbon oxides.

Specialties

2,573,982 (Nuodex Products Co. Inc.) Fungicidal composition comprising a zinc salt of petroleum sulphonic acids.

2,573,978 (Shell Development Co.) Corrosion preventive compositions.

2,573,982 (Shell Development Co.) Tin coating process and oil finishing composition therefor.

2,573,983 (Shell Development Co.) Metal coating process and oil finishing composition therefor.

2,573,949 (Shell Development Co.) Method of metal coating and oil finishing composition therefor.

2,574,964 (Union Oil Co.) Pest control using a sulfurized halogenated petroleum distillate.

2,574,970 (Shell Development Co.) Bituminous composition.

2,574,954 (Tide Water Associated Oil Co.) Rust-inhibiting compositions containing fatty phosphate addition product.

2,574,956 (Tide Water Associated Oil Co.) Rust inhibiting compositions containing phosphate addition product.

2,575,098 (Phillips Petroleum Co.) Insecticide formulation.

2,575,179 (Standard Oil Development Co.) Soil stabilization.

2,575,242 (Standard Oil Development Co.) Selective crab grass herbicidal compositions containing oxo ketones.

Conversions

2,573,906 (Universal Oil Products Co.) Multistage catalytic conversion of bituminous oils.

2,574,247 (Socony Vacuum Oil Co.) Method for conducting thermochemical reactions in the presence of solid material.

2,574,479 (Houdry Process Corp.) Process of converting hydrocarbon material.

Fuels

2,573,933 (Universal Oil Products Co.) Stabilization of motor fuels with hydroxyl phenyl piperidine.

2,574,321 (Standard Oil Development Co.) Process for operating internal-combustion engine with leaded fuel containing excess of scavenging agent.

2,574,664 (Societe Anonyme Documentary Fouchambault & Decazeville) Apparatus for detecting the caloric inputs of gaseous fuels.

2,574,755 (Etyl Corp.) Continuous process for making alkylead compounds.

2,575,001 (Shell Development Co.) Anti-clogging concentrate containing naphthenate, adapted to be added to a hydrocarbon distillate fuel.

2,575,275 (Standard Oil Development Co.) Safety fuel containing tetralin for submarine type marine engines.

2,575,321 (Etyl Corp.) Manufacture of organolead compounds.

2,575,343 (Sinclair Refining Co.) Diesel starting fluid containing ether and N-C-16 hydrocarbons.

2,576,071 (Anglo-Iranian Oil Co.) Aviation or motor fuels containing isopentane-isohexane fractions and TEL.

2,576,648 (Etyl Corp.) Stabilized organic compositions.

Catalysts

2,574,880 (Great Lakes Carbon Corp.) Process of acid-treating clay.

2,575,258 (Standard Oil Development Co.) Regenerating an iron-contaminated cracking catalyst.

2,575,328 (Hercules Powder Co.) Nickel-magnesia-zirconium silicate catalyst.

2,575,427 (Universal Oil Products Co.) Preparation of phosphoric acid catalyst in a precalcined silico-phosphoric acid base.

2,576,653 (Great Lakes Carbon Corp.) Removal of iron from a cracking catalyst.

Lubricants

2,574,994 (Shell Development Co.) Lubricating composition containing cyclo ketone reaction product.

2,575,286 (Standard Oil Development Co.) Lubricating grease composition containing ash and alkali metal salt.

2,575,992 (Standard Oil Development Co.) Acrylic-ester-vinylacetate copolymer lubricating oil additives.

2,576,021 (Standard Oil Development Co.) Lubricating grease containing soaps of tall oil.

2,576,022 (Standard Oil Development Co.) Lubricating grease containing alkali metal carbonate salt.

2,576,023 (Standard Oil Development Co.) Preparing high-temperature lubricating greases containing heterocyclic aldehyde.

2,576,437 (E. I. duPont deNemours & Co.) Thickened fluorinated hydrocarbon oils and greases.

Miscellaneous

2,574,576 (The Pure Oil Co.) Prevention of corrosion of steel by brine containing dissolved oxygen.

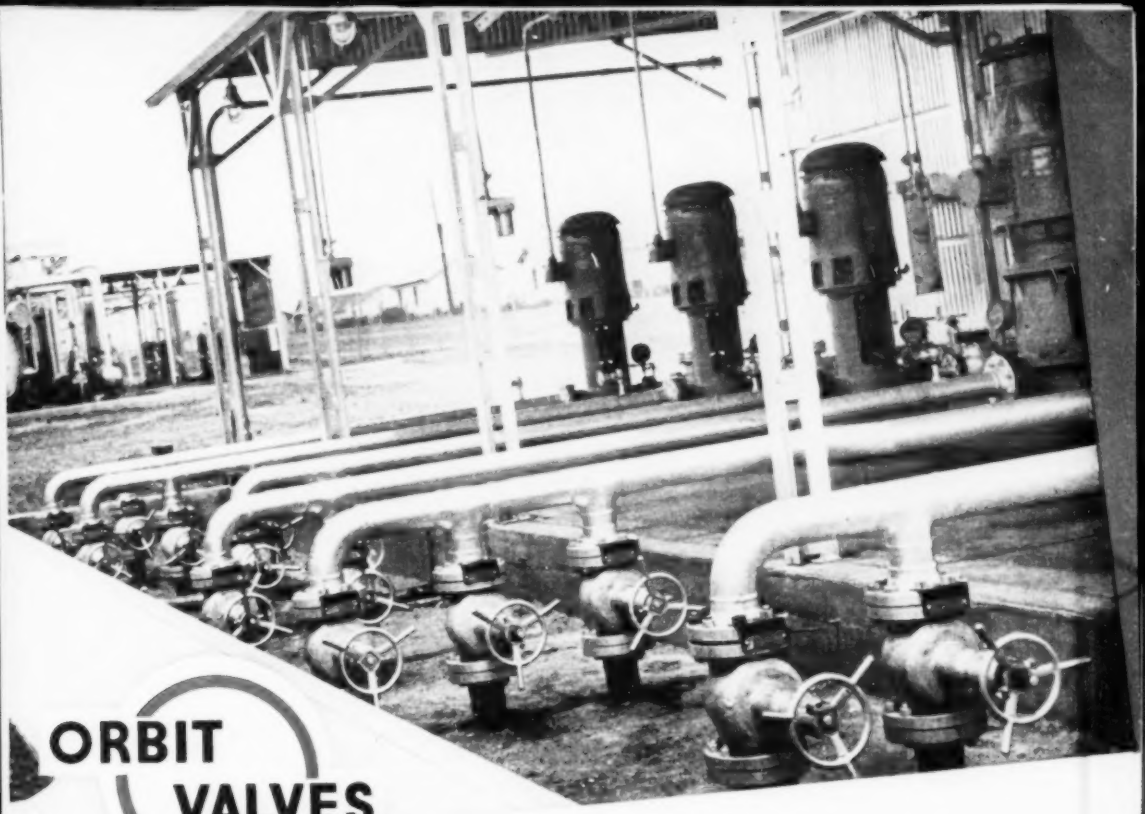
2,574,599 (Socony-Vacuum Oil Co.) Can filling machine.

2,574,807 (The Atlantic Refining Co.) Fat sparing agent and method of producing same.

2,576,696 (Phillips Petroleum Co.) Process and apparatus for dust exhausting emulating granular particles.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent Office at 25 cents each. Order by patent number direct from The Commissioner of Patents, Washington 25, D. C.



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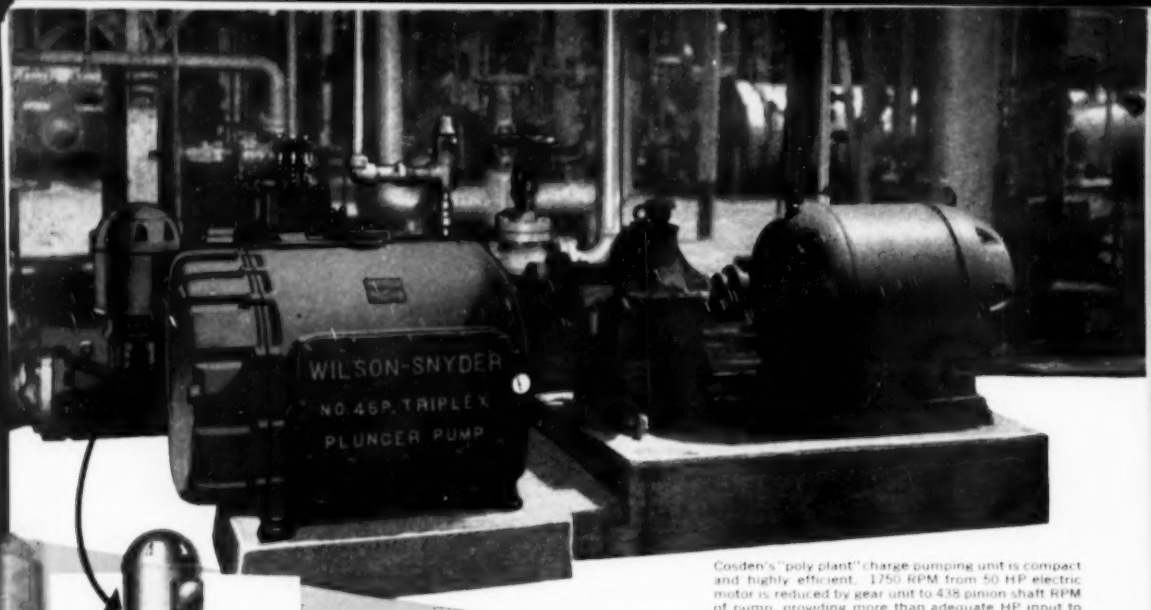
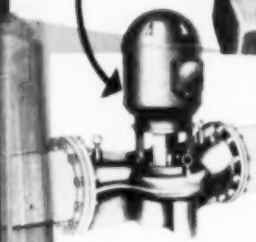


Cosden's "poly plant" charge pumping unit is compact and highly efficient. 1750 RPM from 50 HP electric motor is reduced by gear unit to 438 pinion shaft RPM of pump, providing more than adequate HP input to deliver 110 GPM at 600 psi.



"IN-LINE" centrifugal booster pump with capacity to handle 110 GPM of .52 specific gravity liquid and develop sufficient net positive suction head for Triplex pump to prevent vapor lock.

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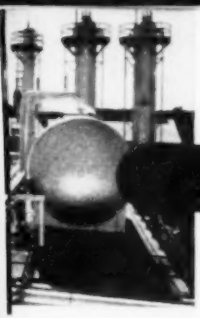


EQUIPMENT PATENTS

Brief Reviews of New Inventions in Equipment

Pressure Gage Is Analyzer

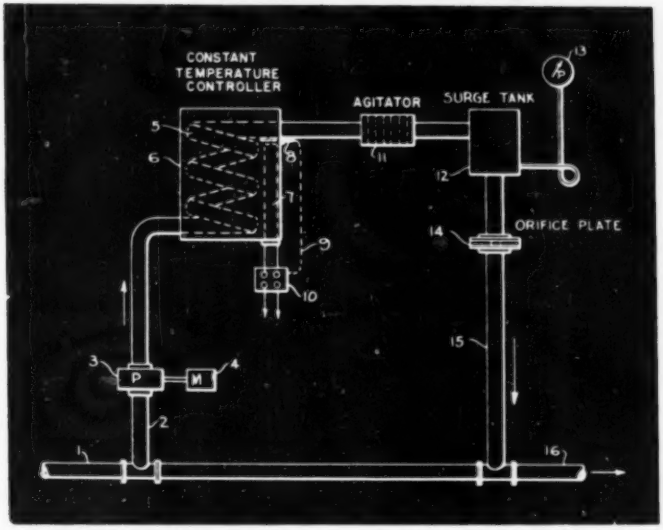


FIG. 1—Water in crude charge stock is indicated continuously by pressure when all other variables are kept constant (U. S. 2,571,470)

THE concentration of volatile constituents in a liquid—for example, water in crude oil feed to a still, or propane, ethane or similar in an oil can be obtained continuously in a device based on the following:

Pressure drop across a fixed flow resistance is a function of the velocity of flow through that resistance. When the mass rate of flow of the liquid is maintained constant, the pressure drop will increase with increasing proportions of the volatile constituent.

The device is illustrated schematically in Fig. 1. The crude oil or other liquid whose volatile constituents are to be measured flows through line 1 at a temperature and pressure at which only liquid is present. A test stream is taken off through line 2 and pumped at a constant rate by a positive displacement pump 3, driven by constant speed motor 4, through heating coil 5 in constant temperature controller 6.

This latter unit can be any type, such as a steel coil imbedded in an aluminum block heater as indicated, and provided with electric heating element 7. Temperature is maintained constant by an automatic thermostatic control, comprising a temperature responsive element 8 near the outlet, connected to a control switch 10.

Agitator, or filter, 11 is optional. Its purpose is to homogenize the liquid, which then passes through a surge tank 12 with a pressure gage 13 connected near the bottom. Liquid then flows through a fixed flow resistance, such as orifice plate 14, and returns to main flow line 16. If desired, a cooler may be used in line 15.

Pressure in line 16 is assumed to be constant; that is, near atmospheric. Therefore, indication on pressure gage 13 will show a pressure substantially equivalent to the pressure drop across the flow resistance 14. In installations where the pressure in the outlet to line 15 is not constant, it is necessary, of course, to provide a differential pressure gage across the orifice plate. The temperature of the liquid flowing through orifice plate 14 is maintained constant at a value at which the volatile constituent exerts an appreciable vapor pressure, preferably almost equal to or in excess of the total pressure on the upstream side the orifice plate. Under these conditions, the reading on gage 13 will indicate the proportion of the volatile constituent in the liquid.

Surge tank 12 may in certain cases be omitted, particularly when a very even rate of flow is maintained by the pump. However, in most instances it has been found that without it, the gage needle vibrated so much that it was impossible to estimate the average or determine the maximum pressure.

U. S. 2,571,470, issued October 16, 1951, to William B. Milligan, assignor to Shell Development Co., San Francisco, Calif.

Patents Issued in November

The following classified listing covers patents issued during the month of November, 1951, believed to be of value or interest to petroleum processing or handling operations:

Catalytic Reactors

2,574,500 and 2,574,850 (Sinclair-Vacuum Oil Co., Inc.)—Apparatus of the moving bed type and method for hydrocarbon conversion.

2,574,297 (Standard Oil Development Co.)—Apparatus of the fluid type and method for contacting fluid solids with gases.

Processing, general

2,573,747 (Phillips Petroleum Co.)—Pebble heater unit for thermal conversion.

2,574,955 (Petrocarbon Ltd., London, England)—Furnace for converting hydrocarbons thermally in the presence of or in the absence of a catalyst.

2,574,370 (Standard Oil Development Co.)—Equipment for the removal of entrained solids from gaseous or vaporous fluids.

2,574,818 (Henry Vogt Machine Co.)—Oil chiller.

2,575,188 (Standard Oil Co., Indiana)—Fractionating tower structural design.

2,575,007—U. K. Svenska Flaktfabriken, Stockholm, Sweden—Cyclone separator.

2,576,056 (Phillips Petroleum Co.)—Pebble type heat exchanger.

2,576,228 (Universal Oil Products Co.)—Air converting cracking reactor.

Tanks and Vessels

2,573,993 (Joseph T. Sparling, Los Angeles, Calif.)—Storage tank construction.

2,574,508 (Granville M. Carr, Wichita, Kans.)—Float supported tank cleaning device.

2,576,146 (Chicago Bridge & Iron Co.)—Support for a seal for a floating roof.

2,576,167 (Chicago Bridge & Iron Co.)—Storage tank designed to withstand internal pressure.

Valves and Fittings

2,574,542 (C. A. Hamer and Paul A. Dewhirst)—Angle fitting combining a valve and a line blind flange.

2,574,661 (T. J. Redd, Tulsa, Okla.)—Back pressure safety valve.

Airetool furnace type cleaner with ball-bearing type motor and 3 tier cutter head.

DONE and DONE RIGHT!

Airetool provides refineries with the powerful tube cleaners for jobs you want done RIGHT.

For full details about Airetool refinery tube maintenance equipment including cleaners, expanders and tube maintenance and accessory tools, write The Airetool Mfg. Co., 336 S. Center Street, Springfield, Ohio.

There's an Airetool Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

Representatives in all Principal Cities

Branch Offices: New York, Philadelphia, Chicago, Tulsa, Baton Rouge, Houston

Equipment Patents

2,574,000 (Everlasting Valve Co.) Valve of the plug cock type.
2,574,428 (Thomas Wheatley, Houston, Texas) Valve of a compressed axle and plug therefor.
2,575,071 (Kiely & Muller, Inc.) Construction for fluid-pressure operated valves.
2,575,074 (H. A. Williams and R. E. Cleland) Low-pressure and vacuum relief valve.
2,575,510 (Mason and Hanger-Co.) Pilot-operated pressure relief valve.
2,575,547 (Mason and Hanger Co.) Pressure relief valve.
2,575,610 (The Ruffo Corp.) Pressure relief valve.
2,575,611 (The Ruffo Corp.) Back pressure relief valve for air systems.
2,576,092 (Crane Co.) Check valve.
2,576,349 (Jeanettes B. Gatchalian, Executrix, Netherlands) Check valve with streamlined flexible sleeve insertion.

Gaskets and Seals

2,573,540 (Jabsco Pump Co.) Rotary shaft seal.
2,575,478 (Victor Mfg. & Gasket Co.) Piston seal.
2,576,873 (Gordon L. Close) Fluid seal.

Instruments

2,573,570 (United States of America) Manometer gas detector.
2,573,950 (The Foxboro Co.) Indicating or recording instrument.
2,574,156 (Wilbur W. Stevenson) Turbine type flow meter.
2,574,206 (Minneapolis-Honeywell Regulator Co.) Instrument casing.
2,574,509 (Industrial Research Institute, University of Chattanooga) Viscosity tester.
2,574,966 (Henry W. Fairlander) Magnetic flow gage.
2,574,972 (Homer A. Hughes) Viscosimeter.
2,575,402 (Minneapolis-Honeywell Regulator Co.) Automatic stem lock for diaphragm valves.
2,575,711 (Westinghouse Electric Corp.) Mass spectrometer recorder.
2,576,936 (Minneapolis-Honeywell Regulator Co.) Analyzing apparatus.
2,576,411 (Foxboro Instruments Co.) Apparatus for measuring physical conditions.

Laboratory Equipment

2,573,807 (Standard Research Laboratories, Inc.) Distillation unit, particularly for mixtures containing low boiling fractions.
2,575,701 (Standard Oil Co., Indiana) Laboratory scale fractionator.
2,575,888 (Martin Co.) Fractionation column.
2,576,809 (Martin Co.) Continuous flow column and inclined fractionating unit.

Pumps and Compressors

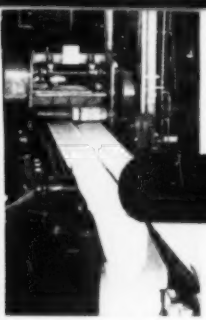
2,573,963 (Alva E. Mitchell) Reciprocating engine.
2,574,224 (Fairbanks, Morse & Co.) Multistage rotary pump.
2,574,814 (Ingersoll-Rand Co.) Reciprocating compressor.
2,574,921 (James P. Johnson) Rotary positive displacement pump.
2,575,506 (Paul Bailey) Acid pump for removing acids from drums.
2,576,175 (Wayne B. Kiley) Rotary piston pump.

Miscellaneous

2,574,001 (Rolac Tool Co.) Pipe nipple reamer.
2,574,305 (Sealed-Vacuum Co.) Ice cube can filling machine.
2,574,854 (John R. Leonard) Pipe wrench.
2,575,262 (Petro-Chem Process Co., Inc.) Prefabricated furnace.
2,575,514 (Selas Corp. of America) Internally fired gas burner with tangent end wall.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent Office at 25c each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.



NEWS OF SUPPLIERS

Manufacturers
Distributors
Engineering Firms

Toledo Firm Enlarges Facilities

A new $200,000 headquarters building was dedicated last month by the engineering firm of Kaighin & Hughes, Toledo, Ohio. The one-story brick structure contains 7,200 sq. ft. of floor space, and houses administrative offices and the engineering department.

The 18-year old company specializes in the design, fabrication and installation of industrial piping and processing systems. Its Chemical and Refinery Division was recently expanded and put under the direction of Alfred Abboud (July PP, p. 766); extensive activity in this field is being planned.

Joins NRC Research Program

Dr. James H. Gardner has joined the petrochemical research department at National Research Corp., Cambridge, Mass. He is to supervise the physical chemistry phases of the petrochemical research program, undertaken jointly by National Research Corp., Electric Bond and Share Co. and United Gas, directed toward the development of new chemicals from natural gas.

Dr. Gardner received his B.S. in chemical engineering from the University of Utah in 1947 and in 1950 was awarded his Ph.D. from Harvard University. Subsequently, he was employed as a technologist by Shell Oil Co. at Deer Park, Tex., and as a lecturer in the chemical engineering department, University of Houston.

New Catalyst Plant in Europe

Koninklijke Zwavelzuurfabrieken ("Ketjen"), of Amsterdam, will become continental Europe's first producer of synthetic fluid cracking catalysts for the petroleum industry, under terms of a contract signed recently with American Cyanamid Co.

Now under construction, the Netherlands plant is designed to permit ready expansion to meet increased demands, expected to result from further refinery growth on the continent. Production of catalyst will begin early in 1953 and will be sufficient to handle an annual refining capacity of more than 56 million barrels of crude oil.

The firm will manufacture Cyanamid's microspheroidal cracking catalysts, using Cyanamid's patents and processes, for sale to Western European oil refiners.

Pacific Valves Expands

Pacific Valves Inc. has acquired the complete plant of Pacific Forge Inc., 1562 North Spring St., Los Angeles, Calif. Pacific Forge will operate as a subsidiary to Pacific Valves, employing approximately 50 employes at present, with plans for future expansion.

Chester Steinberger has been appointed vice president and general manager of the Gulf Coast division of the company. He will continue to make Houston his headquarters, having been associated with Pacific Valves for many years in charge of the Houston office.

The promotion of R. C. Macaulay to the position of vice president and general sales manager, headquarters at the company's main office in Long Beach, Calif., was also announced. He has been associated with the company for many years as sales manager of the West Coast division. John Gryson, formerly sales engineer, replaces Mr. Macaulay as West Coast sales manager.

Fluor Opens Foreign Subsidiary

Fluor Corp. Ltd. has formed a wholly-owned foreign subsidiary, known as Middle-East Fluor, S. A., beginning operations in Saudi Arabia Jan. 1 under contracts that have been signed with the Arabian American Oil Co.

Fluor President D. W. Darnell forecast a "substantial" volume of work because Arabian American's expansion program will require three to five years to complete. J. S. Fluor, executive vice president of Fluor, is president of Middle-East Fluor, incorporated under the laws of Panama (hence "S.A." for "Sociedad Anonima", meaning "Inc.").

Dowell Selects General Manager

Mr. Polk

A. C. Polk, Jr., assistant manager of Dowell, Inc. since 1948, has been named general manager of the firm. He has been with Dowell since 1941. Before his promotion to assistant manager in 1948, Mr. Polk was located in the Houston territory as district manager. Prior to coming with Dowell he was active in oil field work on the Gulf coast.

Mr. Polk attended Rice Institute and the University of Oklahoma, where he majored in petroleum engineering.

Republic Opens Houston Branch

To serve the rapidly expanding industries of the Texas Gulf Coast, Republic Flow Meters Co. is opening a Houston factory branch office. George H. Woodard, project engineer of the company's Chicago factory, will act as manager of the new company office, located at 2426 W. Holcombe Blvd., Houston. He is a mechanical engineering graduate of the Univer-

PENETRATES---

cracks...joints...rivet holes

TO PROTECT METAL 4 WAYS

Rust and corrosion find weak spots in a priming film *fast*, in petroleum service.

That's why KROMIK® has proved such an outstanding, standard priming material, not only in the petroleum industry, but in railway, marine and structural steel service, for year after year after year.

KROMIK outperforms single-pigment primers because, for one reason, it is formulated to *penetrate* into joints and rivet holes . . . to cover evenly, whether brushed or sprayed, avoiding the weak spots that occur with heavy-pigmentation primers that leave "valleys" when brushed. KROMIK dries through, forming a tough, tight film that withstands weather and abrasion . . . lends itself well to application of aluminum paint and either dark or light-colored finishing coats.

Ask for proof. Check your Sherwin-Williams representative or write The Sherwin-Williams Co., 101 Prospect Avenue, Cleveland 1, Ohio.

KROMIK

the 4-pigment primer

1. **PREVENTS RUST**
   KROMIK incorporates the best protective properties of *red lead* to resist moisture —stop rust before it starts.
2. **INHIBITS CORROSION**
   Zinc chromate—another protective pigment —adds extra resistance against corrosion.
3. **RESISTS ABRASION**
   Zinc oxide aids drying and hardness—makes KROMIK equal to most top coats in toughness and resistance to abrasion.
4. **WITHSTANDS WEATHER**
   Iron oxide enables KROMIK to withstand sun and weather even if exposed for long periods before top coats are applied.

COVER THE EARTH

SHERWIN-WILLIAMS

PETROLEUM FINISHES

sity of Texas. His staff will consist of factory trained service and application engineers.

Other recent additions to Republic's field engineering staff include:

St. Louis district office moved to larger quarters at 13 So. Meramec St., Clayton 5, Mo., where William G. Baker is in charge.

Philadelphia district office has been expanded and relocated at 308 Suburban Square Bldg. in Ardmore, Pa., Louis C. Walter continues as district manager.

The Buffalo branch office, located in the Prudential Bldg., has been placed in charge of Charles T. Duffy, a Brooklyn Polytech graduate engineer.

Witco Changes Announced

Witco Chemical Co. and Continental Carbon Co. formally announced removal of their offices to 2281 West Holcombe Blvd., Suite 209, Houston 25, Tex.

The Carbon Black Division of Witco has appointed Harry M. Brubaker assistant sales manager, with offices at 311 Evans Bldg., Akron, Ohio.

Opens New Chem Sales Firm

John P. Harris is now operating his own chemical sales business at 1791 Howard St., Chicago. The firm handles powdered and granular activated carbons, precipitated calcium carbonates and filtration materials.

He is the retired manager of the Chicago Industrial Chemical sales division of West Virginia Pulp and Paper Co.

Aitken Appoints Sales Engineer

E. A. Erickson, active in the instrument and control field in the Houston area, has been appointed to the staff of sales engineers with the M. N. Aitken Co., Houston representatives for Conoflow Corp.

Mr. Erickson's appointment augments staff services in eastern Texas and western Louisiana, as well as the Houston territory.

Moore Licenses British Firm

Moore Products Co. has licensed Sunvic Controls, Ltd., 10 Essex Street, Strand, London, W.C.2, to manufacture Moore industrial instruments in England. The British company, a subsidiary of Metropolitan-Vickers Electrical Co., Ltd., will make Moore products in their plant at Harlow.

Houdry Licenses Blaw-Knox

Houdry Process Corp. has licensed certain processes, designs for equipment, and technical information relating to catalytic treatment of petroleum and other hydrocarbons, to the Chemical Plants Division of the Blaw-Knox Co. This transaction further enables Blaw-Knox to offer services in the engineering and construction of plants and processing facilities to the refining and petrochemical industries.

Start Consulting Firm

Charles D. Lowry, Jr., and Harold E. Bode have organized the firm of Bode-Lowry & Associates to act as consultants in market research and sales development in the chemical field. Offices are located at 80 East Jackson Blvd., Chicago.

Dr. Lowry

The new company will handle all phases of commercial chemical development, studying markets for new chemical products and by-products, reviewing market conditions with reference to chemicals purchased by its clients and supervising application research when the utility of one company's product must be demonstrated in the plant of another.

Because of the previous experience of the organizers, the fields covered in the work of the company will include petroleum processing and petrochemicals.

Dr. Lowry had been associated with Universal Oil Products Co. for 23 years prior to his entry into the field. He was engaged in technical sales of antioxidants for petroleum and food products for UOP.

Mr. Bode was previously employed for 20 years as head of chemical market research and assistant director of chemical patents for the Corn Products Refining Co. He has been in the market research field on his own for six years, as head of the Belmont Chemical Sales Development Co. This company will continue as a sales agency for the firm.

Sprinkler Advisory Committee

In a move designed to advance the science of fire protection, representatives from the sprinkler manufacturing industry have been organized into a new Industry Advisory Conference by Underwriters' Laboratories, Inc.

Selected for their familiarity with the sprinkler industry the following

ONLY ONE MOVING PART..

A small, stainless steel valve that floats on the condensate load... keeps maintenance at a minimum. Continuous discharge under heavy loads, frequent under light loads, gets equipment hotter, sooner and keeps it hot. Over 600,000 Yarways already installed. Sold by distributors throughout the world.

YARNALL-WARING CO. 153 MERMAID AVENUE, PHILA. 18, PA.

(To obtain more data on advertised products see page 104)

You can't jam the new RIGID 65R

Really streamlined pipe threading with this RIGID self-contained die stock

● You don't have to watch it—lead screw can't jam on workholder. New jam-proof drive plate automatically kicks out driving ratchet pawl when standard length thread is cut. Your recent model 65R easily converted—just buy new drive plate, put in place of old plate. Perfect threads on 1" to 2" pipe with one set of 4 high-speed steel dies—sets to pipe size in 10 seconds, mistake-proof self-centering workholder sets instantly! Buy the new jam-proof RIGID 65R at your Supply House.

RIGID

★ Work-Saver Pipe Tools ★

THE RIDGE TOOL CO. • ELYRIA, OHIO

News of Suppliers

men have accepted appointment to conference membership:

Frank J. Fee, Reliable Automatic Sprinkler Co., Inc., Mount Vernon, N. Y.

Ira W. Knight, Grinnell Co. Inc., Providence, R. I.

Frank Rider, The Viking Corp., Hastings, Mich.

H. N. Rider, "Automatic" Sprinkler Corp. of America, Youngstown, Ohio.

Conference members will serve as consultants, making available the experience and technical knowledge of the industry to augment the facilities of the Laboratories. One of their main tasks is to develop practical approaches to the technical problems in safety investigations.

Personnel Changes

J. R. Simpson & Co. Conoflow Corp.'s Chicago representative, announces the appointment of a new associate, J. Robert Simpson III. He joins his father as a partner in the firm.

Ethyl Corp. Malcolm P. Murdock, manager of the central sales region in Chicago, promoted to general manager in New York office. S. T. Pruitt, assistant manager of the central region, succeeds Mr. Murdock as manager.

Black, Sivalls & Bryson Inc. has opened a new office, P. O. Box 655, Wichita Falls, Tex. Mr. L. M. Petrie will be in charge.

General Controls Co. John R. Ferguson, manager of the Salt Lake City branch, has been appointed district manager of the company's branch office at Denver, Colo., and Herb Lindstrom, former Denver branch manager, has assumed a similar position at the Minneapolis branch.

Hills-McCanna Co. E. Frank Miller to eastern division manager with offices in New York City. He was formerly associated with E. F. Drew Co., water conditioning engineers, and General Power Plant Corp. as sales manager.

Celanese Corp. of America E. F. Elbin has been promoted to the position of district manager of the Southwest territory, representing the organic chemicals and organic phosphates departments.

Consolidated Engineering Corp.—Joseph H. Lancor, Jr., appointed director of the Transducer Division.

American Locomotive Co.—Daniel J. Duffin, a former public relations director for the Foster Wheeler Corp., has been appointed to the company's public relations department.

DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

January ★ One of a Series of Interest to the Petroleum Industry ★ 1952

Latest Du Pont Motor Gasoline Survey Due Week of January 21st

The January 1952 edition of Du Pont's Quarterly Motor Gasoline Survey—which reflects nationwide trends in gasoline octane numbers—will start arriving at refiners' offices on January 21. With this edition the survey begins its third full year of continuous publication.

With octane numbers frequently discussed by the press, and public awareness of gasoline quality running high, this issue of the survey is of particular interest.

Refiners have found the Du Pont Gasoline Survey of outstanding value in indicating competitive standings. Many use it also as a sales planning aid.

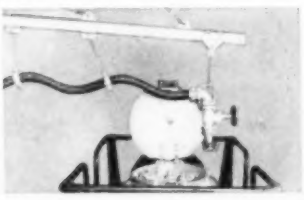
Du Pont-Designed Metal-Flex TEL Unloading Lines Eliminate Many Unloading Problems

Users of Metal-Flex unloading installations designed by Du Pont report that they find many advantages which simplify TEL tank car unloading operations, improve safety and cut labor costs.

Flexibility, for example, eliminates the need for exact positioning of tank cars. This means that one man alone can connect or disconnect the cars. Because older style unloading lines had a tendency to bind, they frequently required two men for this operation.

Flexibility is especially important too, under snow and sleet conditions. Here the Metal-Flex installation is easier to manage than other types of unloading lines.

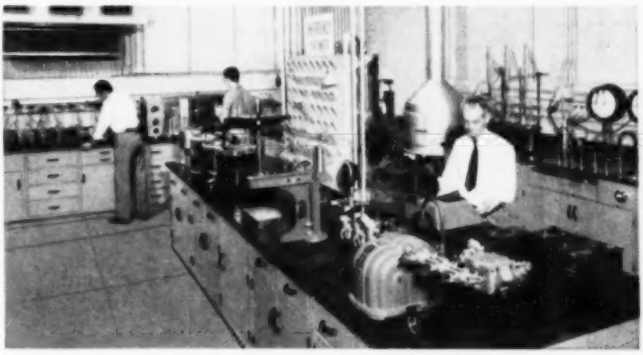
Safety is improved because leaks resulting from stresses are eliminated by the flexible hose and boom arrangement, which also eliminates repacking and the attendant hazards and expenses involved. For more information on the advantages and construction details of Metal-Flex unloading lines, contact your Du Pont representative.



Du Pont Provides Complete Laboratory Technical Service to Meet Specific Refinery Needs

Five fully-equipped Du Pont District Laboratories help refiners in economical use of additives

Whatever your additives problem, technical assistance is always close at hand. Five Du Pont Petroleum Chemicals Division District Laboratories are specially set up for this work. These are conveniently located in El Monte, California; Houston, Texas; Tulsa, Oklahoma; Chicago, Illinois and Wilmington, Delaware. Each is fully equipped to do any required type of testing on motor gasolines. All are happy to be your host if you are in the vicinity.



View of the West Coast District Laboratory inspection section which houses gasoline and light oils test equipment.

New Petroleum Chemicals District Manager Appointments

Alfred B. Mullis has been transferred to New York City as Eastern District Manager of the Du Pont Petroleum Chemicals Division to fill the vacancy created by the promotion of Charles Wirth III to Wholesale Sales Manager of the Du Pont "Kinetic" Chemicals Division. Mullis was formerly located in Houston, Texas, as manager of the Gulf Coast District.

Charles D. Towery, former manager of the Mid-Continent District, takes over as Gulf Coast District Manager and Robert M. Glover has been promoted to District Manager in charge of the Mid-Continent District with offices in Tulsa, Oklahoma.

Every day, more and more refiners are making use of this valuable service. And no wonder! It often means a substantial saving for them . . . in time, in money, in effort. And it frequently supplements their own laboratory activity. Here are a few of the many ways the Du Pont District Laboratory in your area can be of service to *you*.

TEL BLENDING STUDIES

To help check new stocks or determine TEL requirements for a specific blend, the District Laboratory will make tetraethyl lead response studies on any or all of your gasoline stocks.

In addition, many refiners use the Du Pont facilities as a check on results found by their own knock-test laboratories. You can also arrange to have fuels road rated by the Du Pont Test Fleet through the nearest District Laboratory. And qualified laboratory

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *District Laboratories*

personnel are prepared to assist you with proper operation of your CFR knock-test engines.

Since Du Pont supplies refiners with a *complete line* of gasoline additives, our District Laboratories are equipped

LABORATORY MANAGER KEN EDSON reviewing results of TEL blending study for a west coast refinery.

to help you gain added economy and efficiency in the use of additives other than tetraethyl lead.

ANTIOXIDANT EVALUATIONS

Du Pont Antioxidants, Nos. 5 and 22, are made to meet the widely varying response of different gasolines to antioxidants. To help you gain the greatest storage stability at the lowest cost, the District Laboratories will determine the most effective antioxidant for your particular stocks. Their recommendations, which include a complete treating plan, are based on induction period and storage tests, as well as standard A.S.T.M. gum tests.

COPPER CONTAMINATION

Whenever you desire, the laboratories can make a careful check on gasoline samples for the presence of copper. Where copper is found, their recommendations for the effective use of Du Pont Metal Deactivator often result in reduced antioxidant treating costs. In some instances savings have been 35% and higher.

DYES — STABILIZERS

Du Pont District Laboratories also provide a comprehensive dye evaluation service. And they are equipped for testing and evaluating additives for many petroleum products beside gasoline. These include fuel oil stabilizers and grease inhibitors.

QUARTERLY GASOLINE SURVEY

Another important job of the District Laboratories is evaluating the hundreds of samples collected every three months for the Du Pont Quarterly Motor Gasoline Survey. To assure that the surveys are both timely and accurate, the laboratory staffs often work day and night.

AT-THE-PLANT SERVICE

Whenever you want assistance on an additives problem *at your refinery*, a qualified member of our laboratory staff will be glad to work with your own personnel.

In addition to local facilities, our District Laboratories are backed by the specialized services of the Du Pont Petroleum Laboratory and by the broad, continuing research activities of the Du Pont Company.

MANAGES WEST COAST DISTRICT LABORATORY

KENNETH C. EDSON joined the Petroleum Chemicals Division of Du Pont in 1947 as manager of the West Coast District Laboratory in El Monte, Calif.

He came to Du Pont from the Southern California Gas Company, where he was supervisor of the Company's research laboratory. Edson joined Southern California as a process engineer in 1943. Previous to this he was a research chemist for the Skelly Oil Company in Pawhuska, Oklahoma.

After graduating from the University of Nevada, Edson studied for a year in the graduate school of Texas A & M College.

DU PONT Historical Highlights

ONE OF THE FIRST organized research efforts in the U. S. chemical industry was Du Pont's Eastern Laboratory, established at Gibbstown, N. J., in 1902. The original staff numbered 3, and was under the direction of Dr. Charles L. Reese.

Today, Du Pont has 42 research laboratories at 27 locations, staffed with 5,000 men and women, of whom 1,800 are engaged directly in research. With the recently completed $39-million post-war research laboratory expansion program, $33,000 is now invested for each research worker — an investment per man which nearly equals the amount it took to put Du Pont in business in 1802.

Literature — Movies Available

Here is a partial listing of the movies, bulletins, reports, booklets and aids available to you through the nearest Du Pont Petroleum Chemicals Division district office:

Pipeline on Wheels—A 26-minute full-color movie on tank truck safety.

What Makes a Gasoline Good—An 18-minute cartoon movie in color . . . on gasoline quality.

Tank Talk—A 52-page, easy-to-understand safety booklet for tank-cleaning crews. Serial A-1154

DU PONT

Better Things for Better Living . . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Houston, Texas · El Monte, Calif.

IN CANADA: Canadian Industries Limited — Toronto, Ontario — Montreal, Quebec

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-1927

Printed in U. S. A.

New Minerals Yearbook for 1949 Made Available by Bureau of Mines

Minerals Yearbook, 1949. 8½ x 9 in., 1092 pages, indexed, stiff cloth binding, $4.50. (1951). Order direct from the Superintendent of Documents, U. S. Govt. Printing Office, Washington 25, D. C.

An improvement in the newest issue of the *Minerals Yearbook* is the revision of the basis of the national mineral production tables so that for 1947-49 they are on the same basis as the State tables on output. The new national totals pertain exclusively to the production from domestic sources, while in previous editions of the yearbook they included, in some instances, mineral products made in this country from imported raw materials.

Also, the value of U. S. output, as now constituted, is limited to the 48 states and the District of Columbia. Previously Alaska and Hawaii, together with Puerto Rico and other possessions, were included. The Territories and island possessions now appear in separate tables.

The tables of contents at the beginning of each chapter have been omitted in recognition of the adequacy of the index. Other innovations include statistical tables showing minerals produced in each country, world production of lead and zinc on a mine basis, and total mineral imports and exports of the United States.

That the editorial staff has performed again a monumental task, and in comparatively rapid time, is evident; particularly on the basis of the dateline on the editor's introduction: February, 1951.

But that the actual production of this should take so many months more is still to this reviewer's mind a bit hard to understand. A little over a year ago, when the 1948 edition was published, the publication schedule had been stepped up considerably. And at that time, publication of the present, 1949, issue was planned for before the end of 1950. It is indeed unfortunate that the plans could not be realized.

Handbook Deals With Safe Handling of Dangerous Items

Handbook of Dangerous Materials, by N. Irving Sax; 6¾ x 10 in., viii + 848 pages, stiff cloth binding, indexed, $15.00. Reinhold Publishing Corp., 330 W. 42nd St., New York 18, N. Y.

Everyone involved in the handling and shipping of dangerous materials, from safety engineer and plant superintendent to pilot plant and laboratory workers, will benefit from the data assembled in this complete reference handbook. The handbook has an alphabetical listing of 5000 dangerous materials with hazardous properties, antidotes, storage and handling techniques, physical properties, shipping regulations and labeling instructions.

It discusses not only ordinary chemical hazards but dangers due to explosives, fungi and fungicides, and radioactivity. An up-to-date set of Interstate Commerce Commission regulations and a complete text of I. C. C. shipping tariff, as issued by the Bureau of Explosives, is included.

A complete list of references for each of the five sections is also contained in the handbook, and they are cross-referenced and indexed.

N. Irving Sax, toxicologist for the General Electric Co. of Schenectady, N. Y., is the author, with acknowledged assistance from M. J. O'Herin of G. E.'s fungicide laboratory and W. W. Schultz of the general engineering laboratory.

Engineering Information Series Launched by AIChE

Chemical Engineering Progress, Symposium Series No. 1, Ultrasonics; two symposia, multiple authorships; 8½ x 11 in., viii + 87 pages, illustrated, heavy paper cover; members $2.00, non-members $2.75.

Chemical Engineering Progress, Monograph Series No. 1, Reaction Kinetics in Chemical Engineering, by Olaf A. Hougen; 8½ x 11 in., viii + 74 pages illustrated, heavy paper cover; members $2.25, non-members $3.00.

Published by American Institute of Chemical Engineers, 120 East 41st St., New York 17, N. Y., both volumes; members $4.00, non-members $5.50.

Publication of these series under the auspices of the American Institute of Chemical Engineers is an answer for the time being, for basic research knowledge and up to date findings in chemical engineering, at a reasonable cost.

The first in the *Symposium Series* presents studies in the uses and developments of ultrasonic energy as discussed and outlined at Boston, Mass., in May 1950, and Columbus, Ohio, in December, 1950, with applications to chemical engineering processes and operations. It is the purpose of these symposia to present some of the principal limitations and potentialities of applying ultrasonic energy to chemical engineering processes and operations.

For the most part, the chemical engineer is interested primarily in the applications of acoustical energy. Acoustical energy of a magnitude adequate for industrial use has been developed and subjected to service conditions.

C. A. Stokes and J. E. Vivian presented a paper at the Boston symposium treating the fundamentals and applications of sonic energy in the process industries. The physico-chemical effects of ultrasonics are discussed by Alfred Weissler.

The Columbus symposium produced papers dealing with the basic principles of applying sonic and ultrasonic energy by Egon A. Hiedemann, and physical and economic limitations in applying sonic and ultrasonic energy to industrial processes by R. W. Samsel.

The *Monograph Series* is presented by Olaf A. Hougen, professor of chemical engineering at the University of Wisconsin, and internationally known authority in the field. It covers the historical development of chemical kinetics as applied to process design, its present status, and the most promising fields for immediate investigations. There are 287 literature items cited.

Economic Study Discusses Use of Fission Products

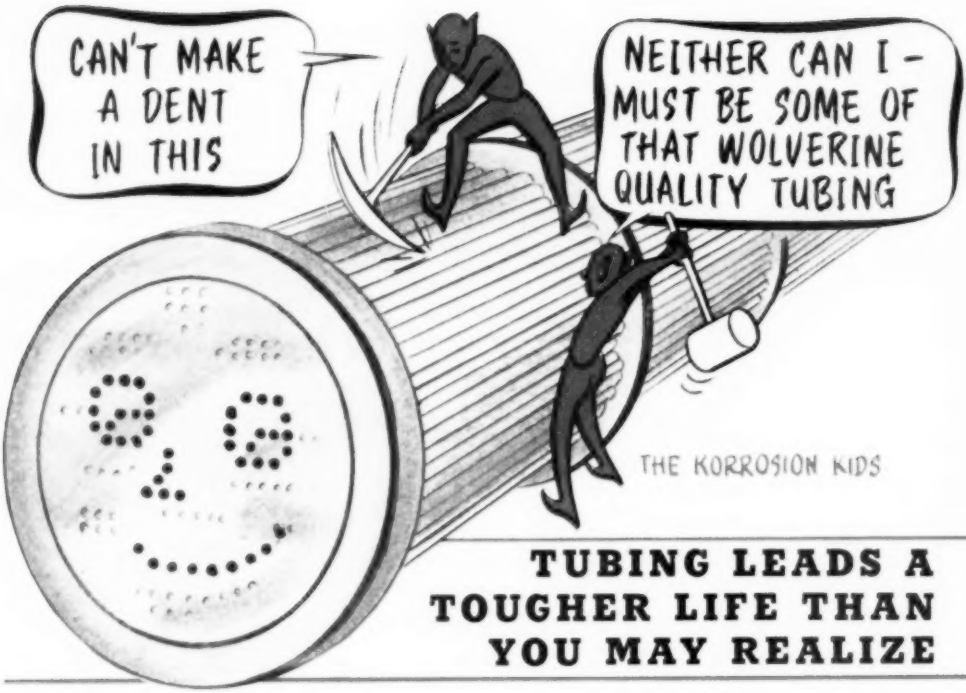
The United States Atomic Energy Commission announces findings and conclusions from a recent techno-economic survey of industrial uses of radioactive fission products. Published by the Stanford Research Institute, the report of survey findings does not necessarily represent opinion or policy of the AEC. It merely encourages further study by industry of possible uses for by-products of atomic energy in the production of plutonium.

According to the report, promising industrial applications for fission products are to be found in various stages of technological development. In the highly speculative area where basic technical knowledge is lacking, possibilities exist for uses in radiation chemistry and flame propagation. Industrial radiography, cold sterilization of drugs and foods, and portable low-level power sources will require at least two to five years for development. Toxicological testing must be included in the experimental and developmental program for any sterilization processes contemplated.

The market study emphasizes that the possible industrial advantage lies in the potential ability to produce certain types of radiation at less cost or in more convenient forms than presently available sources.

Technical problems involved in the design of processing plants to separate the fission products are reviewed. Research programs are sponsored by the Commission at many universities, aimed at assisting industry in this field. A number of prominent industrial concerns have expressed interest in pilot plant operations, especially in the field of radiation sterilization, as suitable fission products become available.

Although primarily an economic study, many scientists and engineers contributed to the development of the report. Copies may be obtained for $1.50 from Project 361, Stanford Research Institute, Stanford, Cal.



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Sulfur Recovery Among Subjects At NGAA Regional Meeting

SULFUR, centrifugal compressors, and valves are the main topics scheduled for discussion at the Permian Basin regional meeting of the Natural Gasoline Association of America, at the Lincoln Hotel, Odessa, Texas, February 29.

The manufacture of sulfur and a discussion of process and equipment requirements and economics of sulfur recovery from waste gases, refinery and natural gases will be covered in a paper by a speaker (as yet unnamed) from The Fluor Corp.

C. L. Moore, assistant chief engineer, El Paso Natural Gas Co., will talk on "Gas Turbine Driven Centrifugal Compressors," and William Bolles, The Lunkenheimer Co., will give a paper on "Valve Maintenance."

The principal address of the meeting will be presented by John Ben Shepard, secretary of state for Texas. One other paper has been scheduled tentatively, "How It Used to Be Done," by Samuel C. Carney. It will be a reminiscence by one of the few remaining old timers on early manufacturing of natural gasoline and the beginnings of present day practices. NGAA members will recall a similar session, which was well-received at the Panhandle-Plains regional meeting in Amarillo in 1947.

"The Cooling Tower," a fellowship hour, will be held by the Natural Gasoline Supply Mens' Association in the late afternoon. It will be followed by a banquet and evening entertainment.

NGAA Expands Research

Furthering its effort to eliminate human errors in low temperature analysis of hydrocarbon mixtures, the Fractional Analysis Committee of the NGAA has begun the distribution of two more liquid samples to the 61 oil companies and commercial laboratories participating in its research program.

The new samples will be Nos. 4 and 5 in the series which was begun in 1948 and reported in the NGAA Proceedings in 1950. They will be blended by the special products department, Phillips Petroleum Co., but their exact composition will be unknown to any of the laboratories. Sample No. 4 is expected to be relatively simple for the analyst, since its composition will range only from C_5 to C_7 inclusive with but traces of some components. No. 5 may present greater difficulties and will range from C_5 through C_8 with four isomers in varying amounts.

All reports will be submitted to the NGAA Secretary, who will identify them only by code number previous to correlation of the data by the committee. Members of the correlating group are: A. J. Miller, Phillips Petroleum Co., chairman of the Analysis Committee; Joe F. Wood, Stanolind Oil Co., chairman of the NGAA Technical Committee; M. F. Wirges, Cities Service Oil Co.; and G. T. Hamblen, Continental Oil Co.

The purpose of anlyzing two additional samples, according to Mr. Miller, is to assess the improvement in accuracy made by participating laboratories as a result of the previous studies and Seminar discussions of errors and their causes.

Results of the current analytical series will be reported at the annual NGAA meeting in April at Houston, when another Seminar on the problem will be held. The ultimate objective is the publication of a text giving all the recommended procedures.

While the current project is confined to analytical problems at natural gasoline plants and to paraffinic hydrocarbon mixtures, laboratories having similar or more complex mixtures are welcome to participate. Any laboratory desiring to take part should write immediately to NGAA headquarters, 122 Kennedy Bldg., Tulsa 3, Okla.

ASTM D-2—Butadiene Test Methods Feature of Spring Meet

A SYMPOSIUM on analytical test method used in the manufacture and utilization of butadiene will feature the meeting of American Society for Testing Materials Committee D-2 on Petroleum Products and Lubricants at the Shoreham Hotel, Washington, February 3-8.

The symposium will be held February 6 and is being sponsored jointly by Technical Committee H on Light Hydrocarbons on ASTM D-2 and the Office of Rubber Reserve. Some 88 other sub-groups of D-2 covering a wide range of subjects within the petroleum field will hold sessions during the six-day meeting.

Oil Man's Calendar

JANUARY

American Institute of Electrical Engineers, winter general meeting, Hotel Statler, New York City, Jan. 21-25.

American Society for Metals, midwinter technical meeting, William Penn Hotel, Pittsburgh, Penna., Jan. 31-Feb. 1.

FEBRUARY

American Society for Testing Materials, Committee D-2 on Petroleum Products and Lubricants, Shoreham Hotel, Washington, D. C., Feb. 3-8.

Western Petroleum Refiners Association, regional meeting, Edison Hotel, Beaumont, Texas, Feb. 7-8.

American Petroleum Institute, Lubrication Committee of Division of Marketing, 32nd yearly meeting, Hotel Book-Cadillac, Detroit, Mich., Feb. 14-15.

Natural Gasoline Association of America, Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas, Feb. 29.

MARCH

Mfgrs. Standardization Society of Valve & Fittings Industry, annual meeting, Hotel Commodore, New York City, March 3-5.

American Society for Testing Materials, spring meeting and committee work, Hotel Statler, Cleveland, Ohio, March 3-7.

National Electrical Manufacturers' Association, Edgewater Beach Hotel, Chicago, Ill., March 10-13.

National Association of Corrosion Engineers, 8th annual conference and exhibition, Municipal Pier, Galvez and Buccaneer Hotels, Galveston, Texas, March 11-14.

American Society for Testing Materials, Chicago district joint meeting with Milwaukee section, American Society of Mechanical Engineers, Engrs. Society of Milwaukee Bldg., Milwaukee, Wis., March 12.

American Institute of Chemical Engineers, regional meeting, Biltmore Hotel, Atlanta, Ga., March 16-19.

Western Petroleum Refiners Association, annual meeting, The Plaza Hotel, San Antonio, Texas, March 31-April 2.

APRIL

National Packaging Exposition, Auditorium, Atlantic City, N. J., April 1-3.

National Petroleum Association, semi-annual meeting, Hotel Cleveland, Cleveland, Ohio, April 16-18.

Natural Gasoline Association of America, 31st annual convention, Rice Hotel, Houston, Texas, April 30-May 2.

MAY

Scientific Apparatus Makers Association, annual meeting, Edgewater Beach Hotel, Chicago, May 6-7.

American Institute of Chemical Engineers, regional meeting, French Lick Springs Hotel, French Lick, Ind., May 11-14.

American Petroleum Institute, Division of Refining, 17th Mid-Year meeting, St. Francis Hotel, San Francisco, Calif., May 12-13.

American Society for Quality Control, 4th annual convention, Syracuse, N. Y., May 22-24.

American Petroleum Institute, Lubrication Committee of Division of Marketing, 2nd yearly meeting, Mayo Hotel, Tulsa, Okla., May 27-28.

JUNE

Chemical Specialties Manufacturers Association, 38th midyear meeting, Hotel Statler, Detroit, Mich., June 9-10.

American Society for Testing Materials, 56th Anniversary meeting, Hotels Statler and New Yorker, New York City, June 23-27.

SEPTEMBER

American Institute of Chemical Engineers, regional meeting, Palmer House, Chicago, Sept. 4-6.

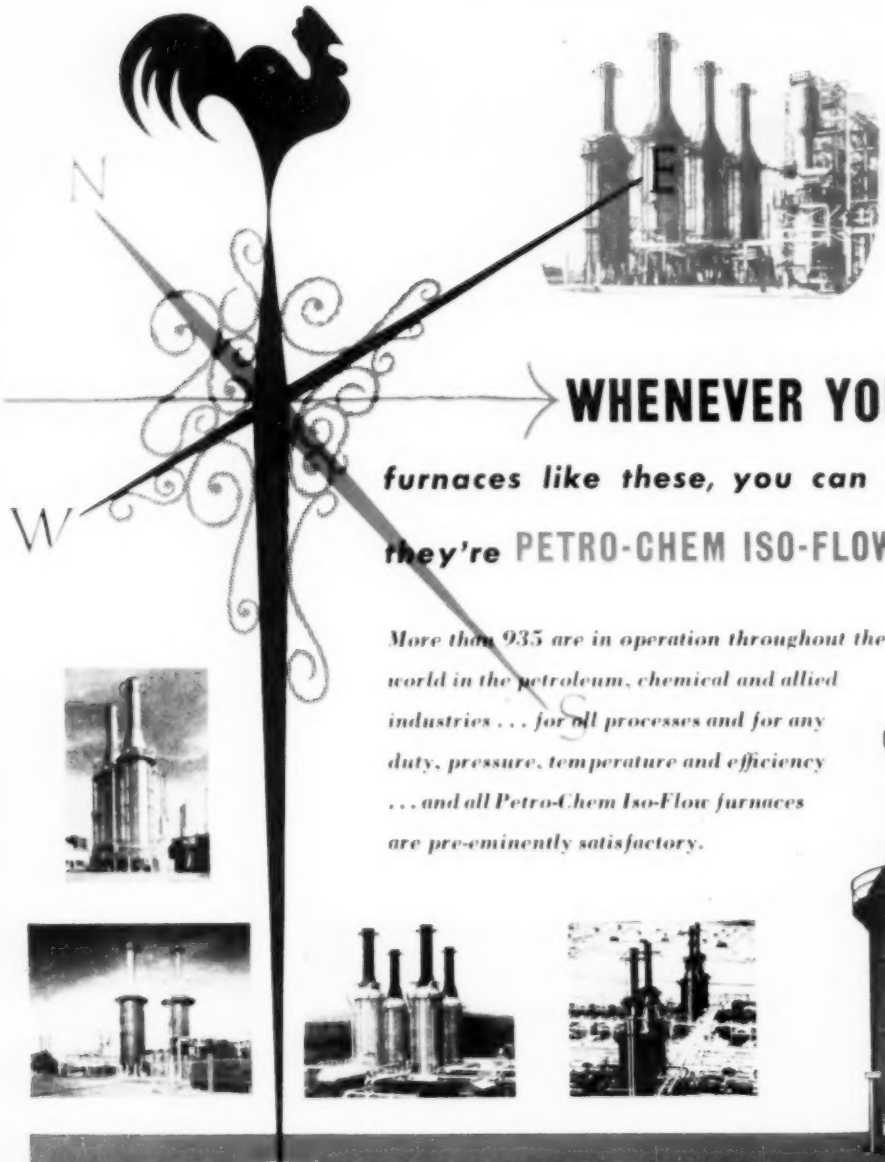
Instrument Society of America, annual conference and exhibit, Public Auditorium, Cleveland, Ohio, Sept. 8-12.

American Society of Mechanical Engineers, Industrial Instruments and Regulators Division, annual meeting, Public Auditorium, Cleveland, Ohio, Sept. 8-12.

Seventh National Chemical Exposition, Coliseum, Chicago, Sept. 9-13.

National Petroleum Association, annual fall meeting, Atlantic City, N. J., Sept. 10-12.

American Institute of Chemical Engineers, regional meeting, Palmer House, Chicago, Sept. 11-13.



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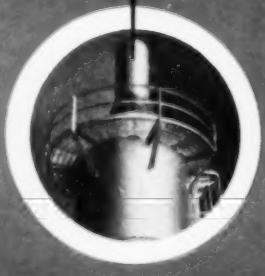

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REPRESENTATIVES

REFINING TRENDS

Current Data on Crude Runs, Product Supply and Demand

U. S. Refiners in Sound Economic Position to Meet Normal '52 Demand

REFINERS in this country start the year in a good economic position to meet 1952 demands, barring the possible emergency of a further disruption of foreign oil supplies and an unexpectedly large increase in military demands.

Stocks of the principal refined products at refineries are the largest on record. In December plants were operating at around 92% of their total estimated capacity of 7,228,500 b/d avg. It is estimated that during the year refinery capacity will be enlarged by around 2% from present figures. These two factors provide some means for expanding the overall rate of operations as demand increases. Most authorities look for an increase in total demand for petroleum products in 1952 of not over 6% more than in 1951.

Total stocks of the principal refined products for the entire U. S. as of Dec. 29, 1951 (API data) were a little over 275,000,000 bbls., which was nearly 25,000,000 bbls. more than was in storage Dec. 31, 1950 (Bureau of Mines data). Stocks the end of this year were divided as follows: gasoline, 122,558,000 bbls.; kerosine, 25,528,000 bbls.; distillate fuels, 83,792,000 bbls.; residual fuels, 43,571,000 bbls.

For the country east of California, stocks Dec. 29, 1951, were over 34,000,000 bbls. larger than on Dec. 31, 1950, the total of 239,490,000 comparing with 205,222,000 bbls. on Dec. 31, 1950. Stocks this year east of California include 107,974,000 bbls. of gasoline; 25,188,000 bbls. of kerosine; 76,480,000 bbls. of distillate fuels; 29,852,000 bbls. of residual fuels. Table I shows the location of stocks of heating oils (kerosine and distillates) and of residual fuels by refining districts for the two dates.

For the country at large, stocks of principal refined products at the year's end were close to the level of 279,000,000 bbls. which the PAD a few months ago said was desirable for refiners to hold on this date in view of anticipated requirements. Principal discrepancy is in residual fuel stocks, which are about 4,500,000 under PAD's figure.

Heating oil stocks are the critical ones for this period of the winter. Table 1 shows that, in relation to Dec. 31, 1950, refiners are in a much improved position this year to meet demands over the rest of the winter. On the East Coast, as shown in Table 1, heating oil stocks are 21% larger than a year ago and for the Gulf Coast districts 16% greater.

These stocks for which data is given, it should be emphasized, are primary stocks in the hands of refiners and are not to be confused with stocks in the hands of secondary suppliers, the volume of which is not reported. The secondary suppliers, who fill a small but none the less important portion of the heating oil demand in the east, are the ones who have been doing the talking in public of a possible shortage in heating oil supplies this winter.

Residual fuel oil stocks east of California on Dec. 29 were 23% greater than at the end of 1950. In the East Coast refining district, where reports have recently come of a shortage of supplies of this product for shipping particularly, stocks in refiners' hands on Dec. 29 were only 4% larger than at the end of 1950; in the Gulf Coast districts they were only 10% larger.

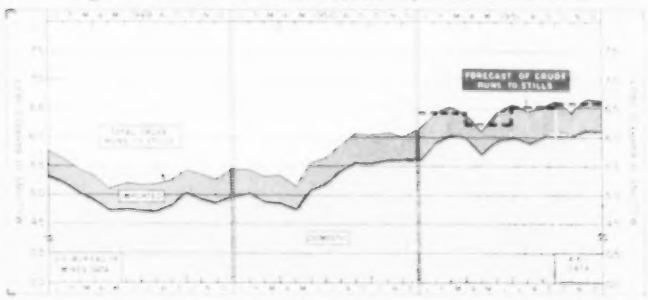
Gasoline stocks in refiners' hands for the U. S. on Dec. 29 were 122,558,000 bbls., nearly 5% greater than at the end of 1950. East of California gasoline stocks, nearly 108,000,000 bbls., were between 6 and 7% greater than on Dec. 31, 1950.

Table 1—Stocks of Oils and Residual Fuel Oils, by Refining Districts, Dec. 31, 1950 (Bureau of Mines and Dec. 29, 1951 API Data)

Figures in 1,000 Bbls.

District	Heating Oils (Kerosine and Distillates)				Residual Fuel			
	Dec. 31, 1950	Dec. 29, 1951	Chg.	% Chg.	Dec. 31, 1950	Dec. 29, 1951	Chg.	% Chg.
East Coast	30,122	36,557	6,435	21	15,543	15,261	− 282	1
Gulf Coast	20,397	23,771	3,264	16	7,266	8,256	990	10
Upper Mid.	3,596	3,940	344	10	499	512	13	3
Ind., Ill., Ky.	14,463	22,063	7,600	52	3,439	6,439	3,000	66
Okla., Kans., Mo.	5,801	11,329	5,528	95	1,102	1,847	745	67
Tex. N. La. Ark.	2,576	3,799	1,223	47	1,055	1,193	138	10
Rockies	2,297	1,971	326	15	510	1,010	500	98
Total U. S. (Ex. Cal.)	79,255	103,609	24,354	27	29,414	34,518	5,104	25
Calif.	13,756	17,962	4,206	33	16,407	14,743	− 2,664	12
Total U. S.	93,011	121,571	28,560	15	45,821	49,261	2,440	7

Fig. 1—Runs Over 6,600,000 b/d at Year End



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Dec. 31 API*	5,745	441	6,186
Dec. 29 API	5,796	436	6,232
Change	+51	−5	+46
% Change	+0.9	−1.1	+0.7
Previous Dec. 22	5,796	436	6,232

Total (1000 bbls.)

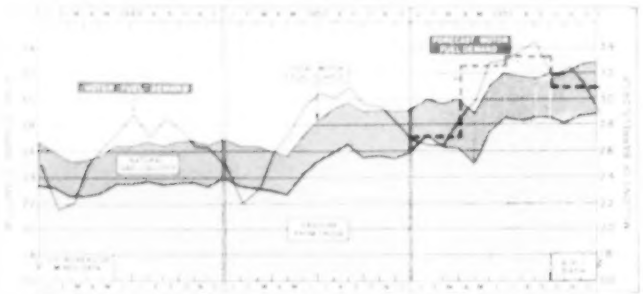
	Domestic	Foreign	TOTAL
Week	40,572	3,052	43,624
Month (30 days)	173,880	13,080	186,960
Change	+220	−15	+205
% Change	+0.5	−0.1	+0.1
Previous Dec. 22	40,352	3,067	43,419

BM Forecast of Crude Runs to Stills (95)

Yields on Crude Runs to Stills

	Gaso. Bbl.	Kero. Mbl.	Dist. Fuels	Resid Fuels
	%	%	%	%
Dec. 31 API*	45.9	7.5	29.2	15.4
Dec. 29 API	45.7	7.5	29.6	15.6
Dec. 31 BM	45.6	7.4	29.5	15.5
Previous Dec. 22	45.7	7.4	29.5	15.4

Fig. 2—Dec. Motor Fuel Output is 1951 Peak



* Natural Gas Liquids include gasoline blended at refineries, and used direct as motor fuel

Fig. 3—Gasoline Stocks Over 122,500,000 Bbls.

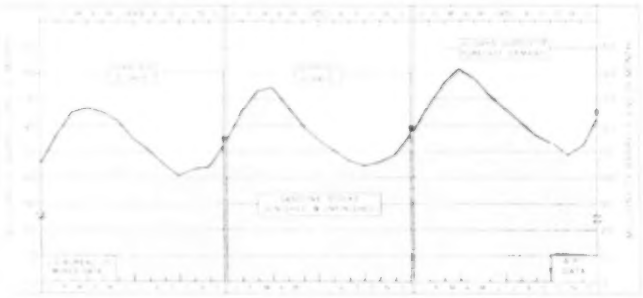


Fig. 4—Sharp Upward Trend in Heating Oil Demand

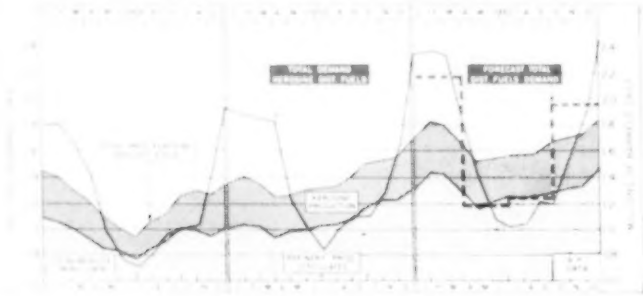
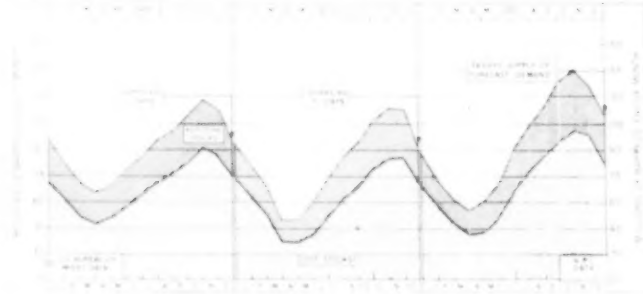


Fig. 5—Heating Oil Stocks Cut Over 19,000,000 Bbls.



Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Dec. '51 API*	2,881	770	3,651
Dec. '51 BM	2,700	749	3,449
Change	-247	-24	-271
% Change	-11.4	-3.1	-10.4

* Through Dec. 29

Total (1000 bbls.)
Burned in Motor Data)

'51 Mon. Ave.*	2,881,304	770,403	3,651,707
'51 Mon. Ave.	2,700,225	749,274	3,449,499
Change	-181,079	-21,129	-202,208
% Change	-6.2	-2.7	-5.5

* Normalized from API data

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

Dec. '51 API*	2,961
Dec. '51 BM	2,800
Change	-161
% Change	-5.4

* Through Dec. 29

Total (1000 bbls.)
Burned in Motor Data)

'51 Mon. Ave.*	1,061,445
'51 Mon. Ave.	963,481
Change	-109,964
% Change	-11.4

* Normalized from API data

BM Forecast of Motor Fuel Demand, 1952

1st Q	2nd Q	3rd Q	4th Q	TOTAL
2,700	2,800	2,900	2,800	2,800

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Dec. '51 API*	122,519
Nov. '51 API	122,700
Dec. '51 BM	120,900
Dec. '50 BM	110,700

* Thru Dec. 29

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Dec. '51 API*	141	1,801	1,942
Dec. '51 BM	141	1,843	1,984
Change	12	+122	+134
% Change	9.3	7.1	7.4

* Through Dec. 29

Total (1000 bbls.)
Burned in Motor Data)

'51 Mon. Ave.*	141,000	1,801,000	1,942,000
'51 Mon. Ave.	141,000	1,843,000	1,984,000
Change	+12,000	+122,000	+134,000
% Change	9.3	7.1	7.4

* Normalized from API data

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Dec. '51 API*	168	1,808	1,976
Dec. '51 BM	168	1,810	1,978
Change	10	+94	+104
% Change	6.3	5.5	5.6

* Through Dec. 29

Total (1000 bbls.)
Burned in Motor Data)

'51 Mon. Ave.*	168,000	1,808,000	1,976,000
'51 Mon. Ave.	168,000	1,810,000	1,978,000
Change	+10,000	+94,000	+104,000
% Change	6.3	5.5	5.6

* Normalized from API data

BM Forecast of Heating Oils Demand, 1952

1st Q	2nd Q	3rd Q	4th Q	TOTAL
2,100	1,000	1,810	2,200	2,047

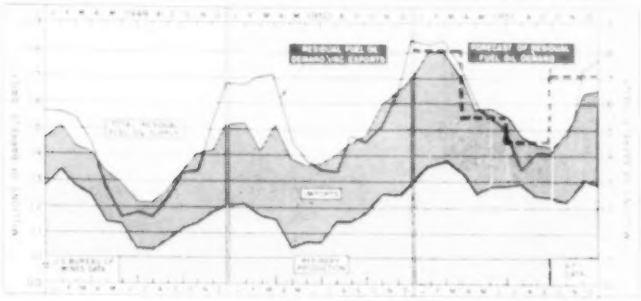
Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
Dec. '51 API*	25,526	93,792	119,318
Nov. '51 API	26,767	98,847	125,614
Dec. '51 BM	26,742	92,750	119,492
Dec. '50 BM	34,750	77,349	112,099

* Thru Dec. 29

Fig. 6—Residual Fuel Demand Reaches New High



Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
Dec. '51	API*		
Dec. '50	BM		
12 Weeks			
12 Weeks			

* Through Dec. 29

Total (1000 bbls.)
(Bureau of Mines Data)

11 Mos. '51*			
11 Mos. '50			
Change			
% Change			

* November from API data

Residual Fuels Demand

Daily Average (1000 bbls.)

Dec. '51	API*
Dec. '50	BM
12 Weeks	
12 Weeks	

* Through Dec. 29

Total Demand (1000 bbls.)

1951	
1950	
11 Mos.	
11 Mos.	

* November from API data

BM Forecast of Residual Fuel Oil Demand, 1952

Residual Fuel Stocks

1000 bbls. end of month

	U. S. Except California	Total U. S.
Dec. '51 API*		
Nov. '51 API		
Dec. '50 BM		
Dec. '51 BM		

* on Dec. 29

Fig. 7—Moderate Drop in Residual Fuel Stocks

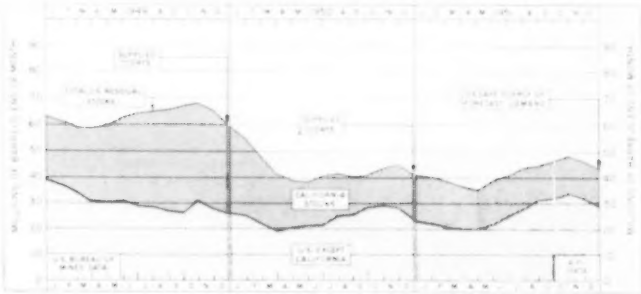
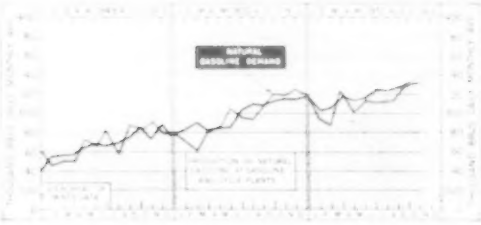


Fig. 8—Production and Demand of Natural Gas Liquids



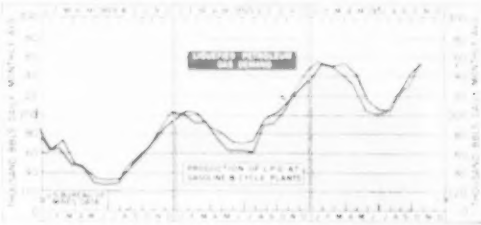
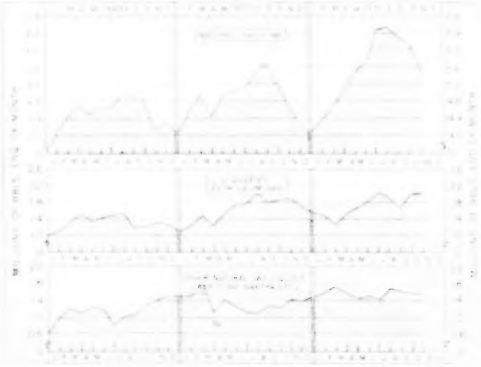


Fig. 9—Stocks of Natural Gas Liquids



Natural Gas Liquids Statistics

Production (1000 Bbl. day avg.) | Demand* (1000 Bbl. day avg.)

	Production: Natural Gasoline	Production: LPG**	Production: TOTAL	Demand: Natural Gasoline	Demand: LPG	Demand: TOTAL
Dec. '51						
Dec. '50						
Change						
% Change						

Total Production (1000 bbls.) | Total Demand (1000 bbls.)

11 Mos. '51						
11 Mos. '50						
Change						
% Change						

Stocks, End of Month (1000 bbls.)

	By Type of Product: Natural Gasoline	LPG	Other Products†	By Location: Refineries	Gasoline Plants	TOTAL
Dec. '51						
Nov. '51						
Dec. '50						

* Demand = refinery inputs + net imports + stocks change + unaccounted for receipts. Data on natural gasoline and LPG production at natural gasoline plants.

** Includ. LPG produced at refineries, which is relatively insignificant.

† Includes butanes, butanes-special, and other products.

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

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WHAT'S NEW!

Equipment
Materials
Processes
Literature

Reviewed by WILLIAM C. UHL, Equipment Editor

TOPS in 'WHAT'S NEW'—1951

Note: Items 1 through 16 in this month's "What's New!" will be found on pages 66-67 of this issue. They are repeat reviews of the equipment, products, and literature most interesting to PETROLEUM PROCESSING's readers during the year just past. As a service to those readers who may have missed them the first time they were published, or who may now find them of value in their daily work, these items have been reviewed again this month. They have also been assigned code numbers which can be used on the regular Reply Cards.

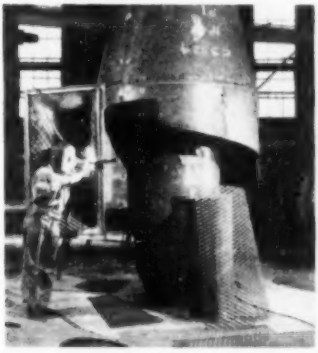
Stainless Steel Packing Glands Designed for General Use

A new series of stainless steel packing glands are now available to accommodate tubes from ⅛ in. to 15/32 in. (⅛ in. I.P.S.) outside diameter. They are designed for general use and ease of installation in process control, pilot plant or laboratory facilities. All types are bored to customers' specifications. Types PG-2 and PG-4 may be used as small stuffing boxes or to seal any round tubes or rods, while Type PG-3 packing glands cannot be used as stuffing boxes for moving parts, but provide excellent pressure or vacuum seals for stationary tubes. Conax Corp., 1515 Main St., Buffalo 21, N. Y.

Circle No. **17** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.



Expanded Metal Ups Strength of Cyclone's Refractory Lining

A new kind of stretched steel material, designed to cut catalytic cracking unit operational costs, by reducing deterioration of the cast refractory lining is being installed at the Baton Rouge, La., refinery of Esso Standard Oil Co. Cast refractory to be put into 10 new cyclone separators will be applied over "Wheeling Expanded Metal" to hold it in place permanently. The material is solid sheet steel that has been slit and then stretched to form the web-like base over which the refractory is cast after the cyclones have been erected. In the illustration a welder is tacking the expanded metal inside the rectangular inlet of one of the cyclones, which were designed by The Ducon Co., Mineola, N. Y., and fabricated for Esso by Steel & Alloy Tank Co., Newark, N. J. The expanded metal is supplied in large, one-piece sheets with diamond-shaped openings. It is cut to shape and formed by cold rolling to fit the concave inner surfaces of the cyclones. Wheeling Corrugating Co., Wheeling, West Virginia.

Circle No. **18** *on Reply Card*

Three Surface Active Agents Offered in Trial Amounts

Three esters of sodium sulfosuccinic acid, recommended for producing stable oil-in-water emulsions and for dispersing solids in organic or aqueous media, are being offered in trial-lot quantities. These surface active agents are homologues of bis (2-ethylhexyl) sodium sulfosuccinate "Aerosol OT" in which the 2-ethylhexyl group is replaced by higher molecular weight groups as follows: Surface Active Agent "BO" Bis (2-butyloctyl) sodium sulfosuccinate; Surface Active Agent "TR" Bis (tridecyl) sodium sulfosuccinate; Surface Active Agent "BPE" Bis (2-p-tert-butylphenoxy-ethyl) sodium sulfosuccinate. All three agents have low solubility in water and high solubility in organic compounds. American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

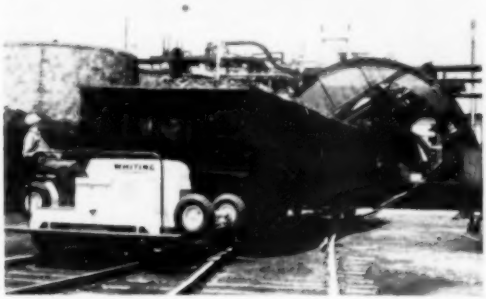
Circle No. **19** *on Reply Card*

Dual-Purpose Mass Spectrometer Serves Efficiently, Economically

A dual-purpose mass spectrometer has been designed for the analysis of mixtures of gases and light liquids, in addition to the determination of ratios of stable isotopes. The Model 21-101 eliminates the use of refrigerants, thus reducing operating costs to the user. Numerous automatic devices serve to minimize operator errors. For mixture analysis a range of 2 to 100 is accomplished, with automatic scanning and recording of spectra from mass 12 to 100. Approximately 15 or more complete runs can be made in an eight-hour shift. For isotope-ratio work as in the determination of the ratio N^{15} to N^{14} in a sample of nitrogen, performance of the instrument is unusual in that the ratio is not only obtained directly by an automatic null balancing method, but is also recorded. The first three decimal places are obtained from decade dials, the last three from the pen-and-ink record. The conversion from mixture analysis to isotope-ratio can be accomplished in a matter of minutes. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

Circle No. **20** *on Reply Card*

RAIL OR GROUND TRAVEL with this car-mover provides rapid, flexible mobility at Indiana Standard refinery



MOVING FULL CARS to the coal dumper is one of several time-saving jobs the unit has performed

How One Refinery Moves Railway Cars Faster

With some 18 miles of railroad track in and adjacent to the Whiting, Ind., refinery, Standard Oil Co. (Ind.) has expedited its handling of railroad cars by augmenting the regular switching service with a special "Trackmobile". The unit permits emergency spotting or respotting of cars and can be moved quickly around the plant because it can travel over the ground as well as on the track. Changeover takes about 30 secs.

Reduction of lost or waiting time on the part of work crews has been an important saving realized through the use of the Trackmobile. A recent example was during a Hydroforming unit turnaround. A 25-man crew was assigned to removal of the catalyst, loading it into cars directly under the unit for temporary removal. Standby service of the Trackmobile permitted immediate movement of filled cars, eliminating lost waiting time.

Removal of sludge coke cars from coker to power house is another job handled by the unit at the refinery. Another one (shown in the photo) is moving coal cars to the dumpers. Most of these jobs can be handled by the operator alone. At Standard, the general foreman of the switching department, who directs the use of the Trackmobile, occasionally assigns a second man to handle car couplings and switching, particularly when several cars are to be taken care of.

Gasoline engine-powered, the unit has a set of rubber wheels for ground use and another set of standard American Ass'n of Railroads wheels for track travel. Operator sits at one end, and a platform with handrails along one edge provides space for carrying a few passengers. The unit couples to all standard railway cars. After coupling, a hydraulic jack raises the coupling slightly, forcing the machine down on the track. A portion of the car's weight is thus transferred to the Trackmobile, enabling it to develop 7350 lbs. drawbar pull. Whiting Corp., Harvey, Ill.

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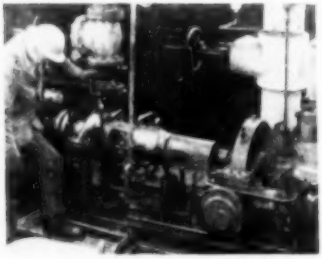

Refinery Capacity Upped 75% By Revised Pump Arrangement

A 75% increase in throughput—17,000 to 30,000 b.d.—was achieved at Standard Oil Co.'s (Ohio) Toledo refinery by installing a mechanical drive steam turbine coupled to a centrifugal pump, replacing a reciprocating steam-driven pump. The change-over also eliminated a severe vibration problem, which Sohio says will insure longer life for other equipment throughout the unit. The turbine is a G. E. Type DP-16. Most of its parts are interchangeable with two others already at Toledo, a DP-20 and a DP-25, thus inventory can be kept down. General Electric Co., Schenectady 5, N. Y.

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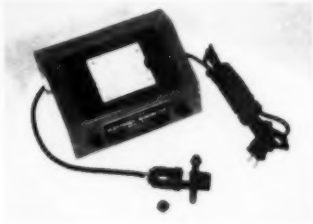


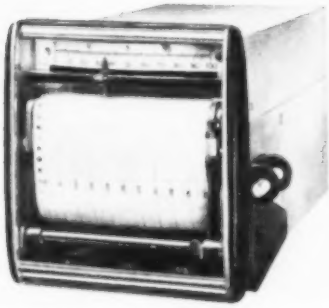
Electronic Flowmeter Measures Very Low Pressure Differences

A new, sensitive, electronic manometer and flowmeter operates from a noble metal thermopile and will measure extremely low pressure differences, having a dual range of 0.001 to 0.1 in. and 0.1 to 2 in. water. It uses no glass or plastic tubes and contains no fluids. The two taps on the gauge tube are simply connected to the two points at which the pressure difference is to be measured. To use the instrument as a flowmeter, the tube is placed directly in the line for low flow rates or connected to pressure taps on two sides of a calibrated orifice for high flow rates. It may be used for direct indications or attached to a recorder. Calibration and accuracy are not affected when long extension cables are used from gauge tube to meter. Available accessories include a five-position switching attachment, permitting monitoring of gauge tubes in five locations with one indicator.

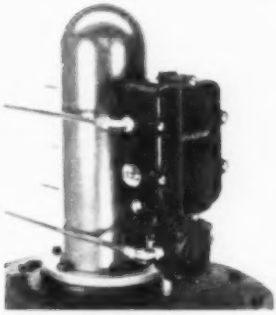
The unit operates on 110 volt, 60 cycle, A.C. A constant voltage transformer is available to eliminate any effects from variations in line voltage. Hastings Instrument Co., Inc., Super Highway and Pine Ave., Hampton 10, Va.

Circle No. 23 on Reply Card

Controllers Cut Transmission Time Lag



MINIATURE receiver-recorder uses only 6 x 6 in. panel space



VALVE-MOUNTED remote-set controller has fast response

Two instruments added recently to the new Foxboro "Consotrol" line and designed primarily for the modern console or graphic type panels, are a Model 53 Recorder and a Model 59 V M (Valve Mounted) Flow Controller. They are companion pieces to the Model 52 Indicating Controller, which was introduced about a year ago. The recorder is in the miniature style, using a 4-in. wide 30-day strip chart with horizontal scale and same scale length as the conventional 12-in. circular chart. It is a receiving instrument equipped with a micrometer control point setting device (no backlash), automatic-manual transfer switch, and an indicating scale to show control point setting and valve motor pressure. It is designed for use with any standard (3-15 psi.) pneumatic measurement transmitter and any standard pneumatically set receiver-controller. Almost six hours of chart record show at all times, and a tear-off bar permits daily chart removal when desired. All connections are ¼-in. female N.P.T., including 20 psi. air supply for the set point transmitter. A ½-in. electrical conduit connection is also provided. Three styles are available: a recorder with remote set and transfer switch, a one-pen and a two-pen recorder.

The valve mounted flow controller has been designed for use on liquid flow control applications where the measurement is transmitted from a Foxboro d/p Cell or other high speed differential pressure transmitter, installed on an orifice in the same line as and within 100 ft. of the control valve. It is a pneumatically set controller of the force balance type, arranged for mounting directly on the valve motor—thus eliminating the lag common to transmission lines. It features fixed proportional band and reset values, made possible by the comparatively narrow range of characteristics of liquid flow control systems having low time constants. The unit has only one moving part, the flapper, which moves only a few-thousandths of an inch. The Foxboro Co., Foxboro, Mass.

Circle No. 24 on Reply Card

An Alloy "Fairy Tale"

"The time has come," the
Walrus said,
"To talk of many things:
But most of all of stainless steel
And all the good it brings,
And why it is that every where
The world its praises sings."

After you've looked at hundreds of catalogs, bulletins, brochures, broadsides and the like, a certain quality of sameness about them begins to show. Any buying engineer, purchasing man, or editor will agree to that.

Consequently, when something just a little different comes along, you perk up and take a second look. And that's exactly what we did a few weeks ago when a copy of "Alloys in Cooperland" hit our desk. The short stanza above, which appears on the first inside page of the booklet was the real "eye-catcher." Here was a refreshing approach in industrial advertising. Here was something that caught our eye because it had been done with imagination and a sympathetic feeling for the reader. Here was something that tickled our fancy because it recognized the child in all of us whose hearts are still young.

As the title implies, this 26-page booklet tells a delightfully amusing "fairly tale" about the Walrus, of Alice in Wonderland fame. But here he relates a story of his trip through a magic city of stainless alloys. Illustrated with Disney-like drawings in color, this half-whimsy, half-serious account of the Walrus does a solid job of describing the various phases of the alloy manufacturing industry from the pattern shop to the shipping dock.

"Alloys in Cooperland" is to be sold to the general public at $1.00. However, copies are being offered without charge to those connected with the chemical and allied industries by Cooper Alloy Foundry Co., Hillside 5, N. J.

Circle No. 25 on Reply Card

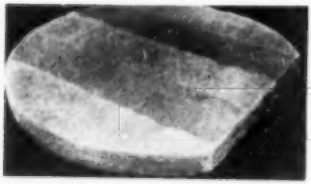
Adequate Lubrication Assured For Tube Cleaners, Air Tools

A new automatic sight-feed lubricator, actuated entirely by pressure of the operating air or steam, assures adequate lubrication of tube cleaners and other air or steam-powered tools. Known as the Elliott pressure-type Lubricator, it requires no adjustment after once set. As long as pressure is supplied, oil is accurately metered into the operating hose. The rate of flow is controlled by a knurled cap on top. Flow is normally set at 25 to 50 drops per minute, readily observed in the sight

Did You Miss "Did You Miss?"

Because the feature "Tops in 'What's New'—1951" appearing in this issue on pages 66-67 provides the reader with the same kind of service that the regular monthly "Did You Miss These?" provides, the latter has been omitted from this issue. Watch for it next month.

ENTRAINMENT SEPARATORS



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In Houston, Tex. — The Rainey Co.
In Los Angeles — Jacobs Eng. Co.

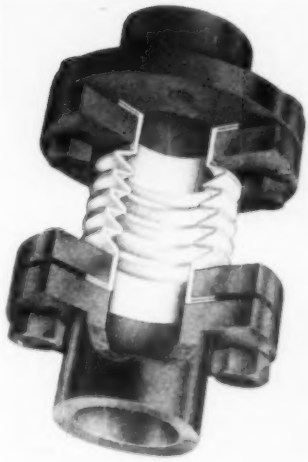
glass and once adjusted it is accurately maintained at the proper rate. Oil is replenished by removing a knurled filler plug, which can be removed and reseated by hand, no further tightening being required for a leakproof fit. A shut-off valve in the operating line must always precede the Lubricator thus making it unsuitable for use with tools controlled at the motor. The Lubricator is supplied in two sizes, one pint and one quart capacities. Elliott Co., Roto Div., Newark, N. J.

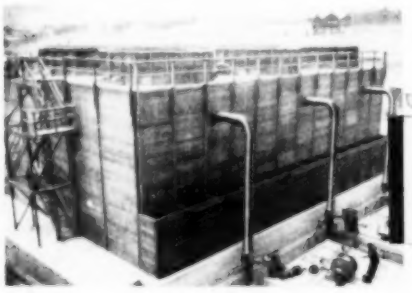
Circle No. 26 on Reply Card

Teflon Bellows Connector Built For Corrosive Piping Problems

The "Linn Crane" Bellows Type Connector, fabricated of chemically inert Teflon, serves as a vibration dampener as well as an expansion joint, connects misaligned couplings and insulates flanges electrically. It has many pipe line applications in the handling of corrosive liquids or gases and solvents. According to the manufacturer, the new connector is electrically non-conductive, flexible even at −94° F. and as strong at 180° F. as at 70° F. End flanges of the joint are French-type envelope gaskets, made integral with the joint for easy assembly between companion flanges and a tight, leak-proof seal on installation. Crane Packing Co., Dept. P-24, 1800 Cuyler Ave., Chicago, Ill.

Circle No. 27 on Reply Card





Regardless of Altitude or Engineering Problems...

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Quality COOLING TOWERS
Meet Exacting Specifications

Tough cooling jobs are easily and efficiently handled by Pritchard Quality Cooling Towers. Take this Mexico City installation. Jacket water from 6 heavy-duty diesels gets a cool-down from 110° to 90° F. at the rate of 12,960 GPM... and at more than 7,000 feet above sea level! Like every Pritchard Quality Cooling Tower, this unit was built and guaranteed to deliver rated performance with output to spare in emergencies. Why don't you, too, find out about the advantages of using Pritchard Quality Cooling Towers to handle your water cooling problems? Consult your nearby Pritchard representative for full information.

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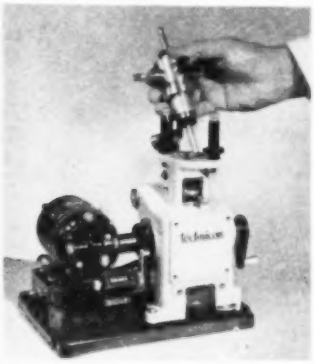

Small Volumes Measured Accurately by Micro Pump

The Technicon Micro Pump is a precision instrument for accurately metered deliveries of micro-volumes, from 0.001 to 1.0 ml. Under identical conditions, the pump will deliver identical volumes at the same setting. The scale is absolutely linear so that the exact amount being pumped can be read directly from the scale at any given point. The vernier setting can be changed at will even during operation. Titrations, micro-injections and other laboratory procedures can be handled by this pump. Two chambers, each interchangeable with the other, are available with the pump. One delivers from 0.001 to 0.1 ml. per stroke, and the other delivers from 0.01 ml. to 1.0 ml. per stroke. Liquids of a wide viscosity range can also be handled. For very slow operation the pump can be hand-operated. The stroke total can be read directly from the mounted counter for simple calculation of volume delivered. Interchangeable synchronous motors give pumping speeds of 2, 10, 25, and 50 strokes per minute. The standard pump will operate under pressure up to 70 psi. Special pumps are available for higher pressures. Technicon Micro Pumps can be ordered with glass pump parts or stainless steel parts (Carpenter Type 20). Technicon Chromatography Corp., 215 East 149 St., New York 51, N. Y.

Circle No. 28 on Reply Card

Surface Thermometer Attaches To Any Material, Good to 300 F.

The Model 310 Surface Temperature Thermometer, with a range of 0 to 300° F. in 2° increments, is designed for checking outside temperatures of pipes, electric motors, bearings, cylinder blocks, and any other similar jobs. It can be affixed quickly to any flat surface by applying a small amount of Silicone grease, which is supplied with the instrument, and sticking it in place. The grease does not melt, and holds the instrument throughout its ranges of temperature, providing a good thermal coupling. The instrument is also furnished with a small magnetic clamp for installing it on steel or other ferrous surfaces. A highly reflective mirror on the dial insures the thermal element against external radiation effects. The thermometer is 2 in. in diameter and weighs one ounce. Pacific Transistor Co., 11921 West Pico Blvd., Los Angeles 64, Calif.

Circle No. 29 on Reply Card

"V" Port, Globe Valve Designed To Aid Throttling Service

Selecting a valve for throttling service is facilitated by the manufacture of a new "V" port, globe valve. This valve is a conventional type O, 3S and Y, Bolted Bonnet Globe Valve, with a special disc designed to regulate flow through four "V" shaped ports. (See illustration.) Constructed of cast carbon steel, the valves are furnished with 12% chromium stainless steel trim. An inli-

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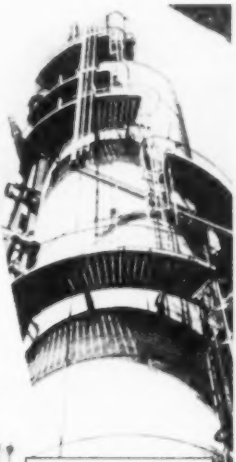
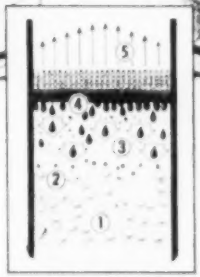
WITH

METEX MIST ELIMINATORS



From the recovery of liquids entrained in discharge gases to the removal of contaminators in further processing, these simple knitted wire pads are daily contributing to greater or grade throughput, increased efficiency and lowered costs in refineries from coast to coast.

Metex Mist Eliminators do just one thing — remove liquids entrained in gases. The diagram shows how they are doing it in stills, towers, cats, knock-outs, evaporators and other vessels.



HOW IT WORKS

Efficiencies 95% and better • Little if any pressure drop • Easily installed in existing equipment • Made of practically any metal • No valves or moving parts to service.

Worth looking into, isn't it? For full information, write for free copy of "Metex Mist Eliminators," an 8-page brochure that's packed with facts.

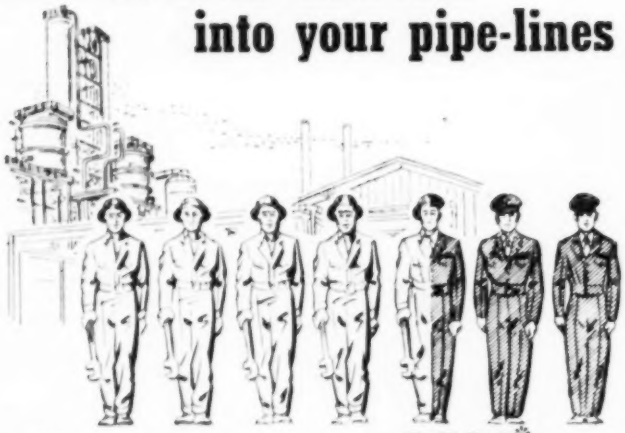
METAL TEXTILE CORPORATION

KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

631 East First Avenue, Roselle, N. J.

(To obtain more data on advertised products see page 104)

Build STAMINA into your pipe-lines



Reduce maintenance with D-F S-E* *Joints*

Shortages of manpower require you to build stamina in your lines. **Directed-Flexing Self-Equalizing*, an exclusive feature of Badger Expansion joints, assures all-curve flexing in the corrugated member. Thus, localized flexing stresses cannot form . . . metal fatigue cut to a minimum . . . breakdowns are virtually eliminated.

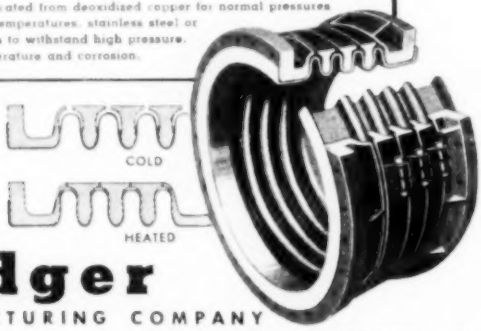
But that's not the whole Badger story. In addition to controlling the flexing movement *within* each corrugation, the specially designed Self-Equalizing Rings also control intra-corrugation movement. For unbeatable stamina be sure you get the exclusive Badger combination — Directed-Flexing Self-Equalizing — when you buy . . . specify Badger Expansion joints for every job.

Only Badger Expansion Joints have Directed-Flexing Self-Equalizing rings which progressively control the movement of the all-curve corrugations.

Plus 5 other big features

- Packless . . . pressure-tight single tube — requires no maintenance
- Compact . . . approximately the size of flanged fitting
- Special forming . . . no structure weakening stresses
- Controlled heat treating . . . assures long life
- Wide range of traverse — pressure — temperature

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.



Badger
MANUFACTURING COMPANY
230 BENT STREET, CAMBRIDGE, MASS.

What's New!

cator is provided to adjust accurately the flow, and to tell the position of the disc. Available with flanged or butt-welding ends, they come in the following sizes: 150 and 300 psi series, $1\frac{1}{2}$, 2, 3, 4, and 6 in. Pacific Valves Inc., 3201 Walnut Ave., Long Beach 7, Calif.

Circle No. 30 on Reply Card

Trade Literature

Tank Capacities Charted

How To Figure Horizontal Tank Capacities, an $8\frac{1}{2}$ x 11 in., cardboard chart which enables one to figure the number of gallons of liquid in any horizontal tank without the use of tables, formulas, figures, or computations, any depth of liquid from 1/10 in. to full capacity is taken into account. Armstrong Machine Works, Three Rivers, Mich.

Circle No. 31 on Reply Card

Proper Materials Control

Production Control Systems and Procedures, Publication X-1268; 56-page book details a unique method of materials control, illustrated with typical forms and charts, procedures for engineering, production planning and progress, machine load, material and tool procurement and control. Remington Rand Inc., 315 Fourth Ave., New York 10, N. Y.

Circle No. 32 on Reply Card

Radium Safety Precautions

Safety Code for Industrial Instrument Use of Radium; 10-page booklet advocating rigid restrictions in providing for safe but practical procedures in handling and storing radium; covering radium capsules, holders, and shipping containers; control of personnel is discussed regarding methods of protection after occasional exposure to radium. Instruments Inc., Wright Bldg., Tulsa, Okla.

Circle No. **33** *on Reply Card*

Practical Cooling Towers

Aqua-Therm Industrial Cooling Towers; four pages describing scrubbing and process towers, acid-proof construction and equipment, featuring a stoneware saddle fill which provides 50 sq. ft. surface area for each cu. ft. of volume, allowing for reduction of customary tower height, basin area and pumping head. Aqua-Therm Inc., 768 Albany St., Dayton 1, Ohio.

Circle No. **34** *on Reply Card*

Petroleum Processing Index

PETROLEUM PROCESSING *Index for 1951;* includes subject and author indexes for all feature articles and regular departments for the 12 issues of this magazine published during 1951. Platt's Petroleum Publications, 1213 West 3rd St., Cleveland 13, Ohio.

Circle No. **35** *on Reply Card*

Lubricating Control Valves

Proper Valve Lubrication . . . A Prerequisite to Good Control; reprinted from *Instrumentation,* Vol. 5, No. 4, Third Quarter, 1951; four pages describing essentials of proper valve lubrication to insure good control; includes chief functions of valve lubricants, sealing aspects, most desirable properties of a lubricant, influence of temperature changes and a chart to aid in the selection of the proper valve lubricant. Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **36** *on Reply Card*

Electric Control Center

"New Motor Control Center, Bulletin GEA-4979A; 24-page booklet illustrating NEMA sizes 1 through 5 starter units for all industries where two or more A-C motors, up to 200 hp., are controlled from a central location; capable of withstanding short circuit stresses up to 25,000 amp., with ready accessibility and safety features. General Electric Co., Schenectady 5, N. Y.

Circle No. **37** *on Reply Card*

Remote Reading Level Gages

Jerguson Truscale Remote Reading Liquid Level Gages, Bulletin No. 176; eight pages of data on instruments of this type recommended for protection of boilers, deaerating tanks, storage tanks, and the like. Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

Circle No. **38** *on Reply Card*

Acid Handling Pumps

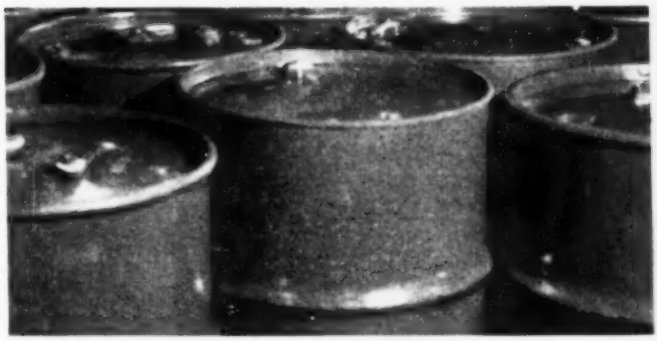
Series E Durcopumps, Bulletin P-1; six pages describing two centrifugal pumps designed for severe corrosive service; complete interchangeability of wet end alloy parts permit pump adaptation to various corrosive solutions. The Duriron Co., Inc., Dayton 1, Ohio.

Circle No. **39** *on Reply Card*

Glass Pipes, Valves, Fittings

Pfaudler Heavy Duty Glass-Lined Pipes, Valves and Fittings, Bulletin No. 886; 12-page booklet, indexed, with diagrams, dimensional tables, standard pipe and valve functions and features of redesigned standard fittings. The Pfaudler Co., 1000 West Ave., Rochester 3, N. Y.

Circle No. **40** *on Reply Card*



How to renew old drums in just 7 minutes

THAT'S right! Used drums restored to like-new condition . . . cleaned, paint-stripped, rinsed, dried, and repainted—in just 7 minutes! That's how fast Oakite cleaning works in one barrel-house.

Reconditioning barrels and drums the Oakite way has these extra advantages: Fewer rejects . . . more uniform paint stripping . . . better adhesion for new paint. Elimination of paint build-up on steam coils . . . no clogging of drains and sewers.

Your Oakite Petroleum Service Representative will gladly help you get better, faster drum-conditioning. Call him today.

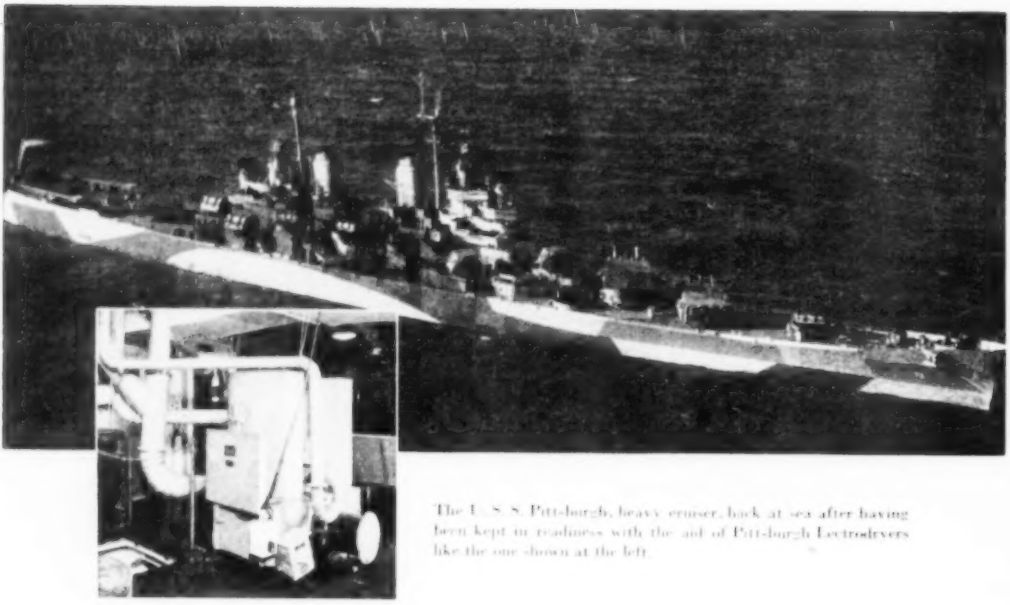
FREE BOOKLET F7629 tells all about drum-conditioning—tells how to save time and money on other big cleaning jobs. Write Oakite Products, Inc., 50D Thames St., New York 6, N. Y.

Technical Service Representatives Located in Principal Cities of United States and Canada

OAKITE
PETROLEUM SERVICE DIVISION

Suppose YOU

had to "warehouse" a 13,000-ton cruiser . . .



The U. S. S. Pittsburgh, heavy cruiser, back at sea after having been kept in readiness with the aid of Pittsburgh Lectrodryers like the one shown at the left.

The Navy did it by making the ship its own warehouse. In "Operation Mothball" the hull was sealed tight against outside moisture and the relative humidity maintained below 30% with the aid of Lectrodryers®. Now "Operation Zipper" has put the Pittsburgh back in service, its vitals rust-free and corrosion-free.

To warehouse safely any goods that WILL be unwanted moisture would spoil—depend upon Lectrodryer. A Lectrodryer will DRY your storage-space air continuously, economically, automatically. Lectrodryer* engineers will work with you to design your entire DRYing operation—including selection and installation of moisture-vapor barriers to control atmospheric WILL. Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

Combination Vent Valves

BS & B Combustion Pressure-Vacuum Vent Valves, Bulletin E-601, 24-page booklet gives description on two models: VVH, a cantilever type valve arrangement with composition gasket and hinged cover; and VVFA, which in combination with a conventional type flame arrester bank provides the necessary safety in the storage and handling of flammable liquids and gases; sizes and specifications, prices, operational data and 14 relieving capacity charts, one for each valve size, included. Black, Sivalls & Bryson Inc., 7501 East 12th St., Kansas City 7, Mo.

Circle No. **41** *on Reply Card*

Tower Packings, Tower Design

Tower Packings and Packaged Tower Design, a 120-page, stiff-bound book, prepared by Max Leva, consulting chemical engineer, covering general fundamentals, mechanics of packed tower operation, and including considerable data in the form of tables, charts, nomographs, etc. (See detailed review in *Books* section, this issue, page 87). Available to engineers directly interested and concerned with the problem. United States Stoneware Co., Akron 9, Ohio.

Circle No. **42** *on Reply Card*

Lubricated Plug Valves

Porter Lubricated Plug Valves, No. 19-V, 32-page catalog covering entire line of lubricated plug valves now available; engineering dimensions and illustrations included with prices, accessories, pressure-temperature ratings and materials of construction. Porter Valve Division, H. K. Porter Co. Inc., 1120 No. Peoria St., Tulsa 1, Okla.

Circle No. **43** *on Reply Card*

Engine Development

Development of the Modern Gas Engine, a paper presented by R. L. Boyer and W. R. Crooks at the Oil and Gas Power Conference of the ASME, 16-page booklet discussing the development of modern internal combustion engines, diesel and gas-diesel engines, stressing the economics of fuel use; with data, photographs and charts. The Cooper-Bessemer Corp., Mt. Vernon, Ohio.

Circle No. **44** *on Reply Card*

Carbon and Graphite Products

"National" Carbon and Graphite and "Karbate" Impervious Carbon and Graphite Products, Catalog Section S-5005, 20 pages describing centrifugal pumps, pipe fittings and valves, and heat exchangers of porous and impervious carbon and graphite, for application in the chemical and process fields; metallurgical, mechanical and electrical equipment also illustrated, with information on sizes and physical characteristics of each product. National Carbon Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **45** *on Reply Card*

Effective Insulation

Kaylo Heat Insulation, KH 3-511, an eight-page bulletin with latest information about the use of hydrous calcium silicate insulation, its performance, application and physical characteristics as used in block and molded pipe insulation on commercial projects, with allowances at temperatures up to 1200° F., standard sizes, recommended thicknesses and forms included. Kaylo Div., Owens-Illinois Glass Co., Toledo 1, Ohio.

Circle No. **46** *on Reply Card*

Proper Handling of Sodium

Handling Metallic Sodium; 24-page booklet provides data on safe handling methods in commercial operations with metallic sodium, covering the properties of sodium, its commercial specifications, methods of shipping, cleaning process equipment, safety precautions and first aid. Na-

SHIPMENT = SAMPLE

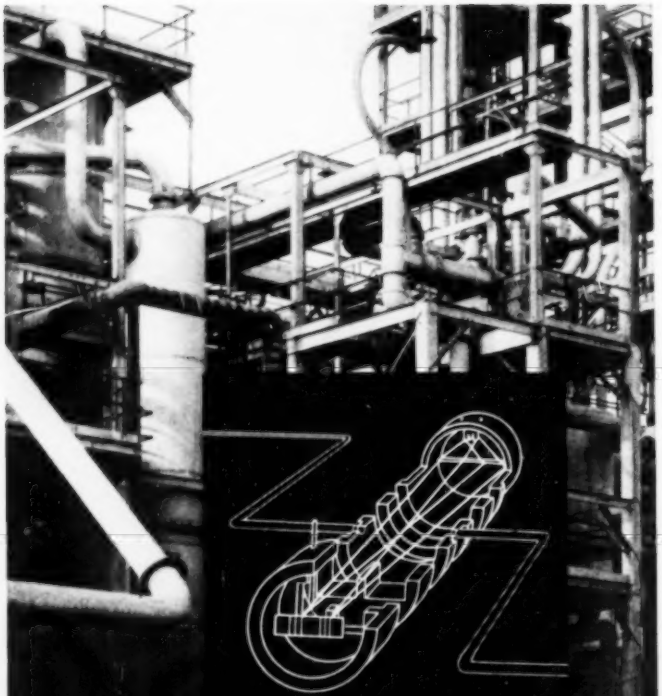
You can be sure of uniform shipments of W. C. Hardesty Co., Inc. Fatty Acids because . . . Hardesty's production in its own modern plants is "Standardized" to deliver every shipment exactly . . . as per sample.

RED OIL · WHITE OLEINE · STEARIC ACID
HYDROGENATED FATTY ACIDS · ANIMAL & VEGETABLE FATTY ACIDS
GLYCERINE · STEARINE PITCH

W. C. HARDESTY CO., INC.
41 EAST 42nd STREET, NEW YORK 17, N. Y.

PLANT: DOVER, OHIO • IN CANADA: W. C. Hardesty Co. of Canada, Ltd., Toronto

(To obtain more data on advertised products see page 104)



IN STYGIAN DARKNESS THE SHADOW OF A VAPOR THINKS FOR A GIANT

Infrared shadows, cast by process gases in the sealed cells of a lightless chamber, permit critical concentrations of a gaseous component to be recorded and to control industrial processes through the Baird Associates Plant Stream Analyzer.

This sensitive, accurate, reliable instrument has proved its worth in control applications involving: n-Butane in methane, ethane, propane, iso-butane, CO, and CO_2; methane in natural and manufactured gas blends; carbon dioxide in expired air; acetylene in 14-component mixture; methane in 14-component mixture; carbon dioxide in 7-component mixture; hydrogen cyanide in 8-component mixture; ammonia in 7-component mixture; acetone in air; acetylene in hydrogen cyanide.

Your process control may benefit by use of the Baird Associates Plant Stream Analyzer. Bulletin 36 gives detailed information; ask us about the use of this instrument in your control problems.

Baird Associates, Inc.
INDUSTRIAL PHYSICISTS
33 UNIVERSITY ROAD CAMBRIDGE 38, MASS.

What's New!

tional Distillers Chemical Corp., Plant and Sales Offices, State Rd., Ashtabula, Ohio.

Circle No. **47** *on Reply Card*

Revised Gas Analysis Reference

Fisher Gas-Analysis Manual, 4th revised edition, 60-page manual, discusses theory of gas analysis, gives details regarding procedures involved in various analyses, describes maintenance and operation of Fisher Unitized Gas Analysis Apparatus. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Penna.

Circle No. **48** *on Reply Card*

Diesters Available

Esters for Synthetic Lubricants, Bulletin EM-671; 10-page booklet describes three diesters now available to synthetic lubricants and specialty grease manufacturers; includes physical properties, viscosity-temperature relationships and comparisons with other diesters. Emery Industries, Inc., Dept. S, Carew Tower, Cincinnati 2, Ohio.

Circle No. **49** *on Reply Card*

Low-Cost Copy Machine

Copyflex Model 20, Booklet A-2009, four pages introducing a standard 46" printing width machine, which produces in black or white or in any of 20 color combinations, an exact replica of anthing drawn, written, typed or printed on translucent paper (stencils or negatives not needed); engineering drawings or large office forms can be printed with ample leeway for the customary 42" roll stock, or for multiple cut sheets side-by-side; includes specifications. Charles Bruning Co. Inc., 100 Reade St., New York 13, N. Y.

Circle No. **50** *on Reply Card*

Aluminum Stearate Lubricants

Cutamid Aluminum Stearates for Lubricating Greases; Leaflet 594; 20-page booklet describing the applications and properties of aluminum stearates used in lubricating grease manufacture, with a brief dis-

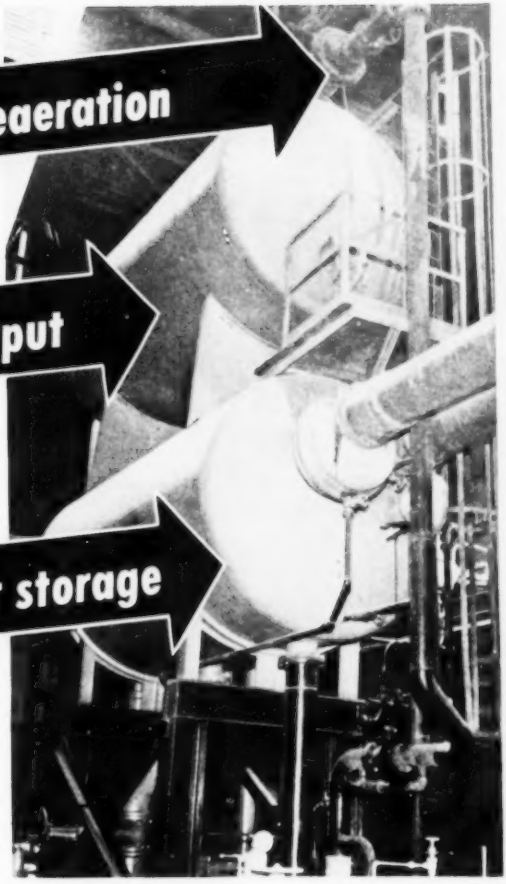
For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

83⅓% greater deaeration

60% more heater output

400% extra hot water storage



at ½ the cost of a new heater

...an example of GRAVER modernizing engineering

When you bring a water treatment problem to Graver, you can be sure of not only authoritative advice and modern equipment design, but more than that . . . *recommendations that consider your pocketbook* . . . the most effective solution at the lowest cost, with savings that may surprise you.

Here's an example.

In 1941, a midwestern steel mill installed a Graver Deaerating Heater, which gave completely satisfactory service for 10 years.

Because of expanded operations and additional boilers, the mill then needed more water heater capacity and storage, and also better quality water. After a careful on-the-spot examination, the Graver engineers incorporated modern internal design to the *existing outer shells* and produced the following results:

	ORIGINAL INSTALLATION	CONVERTED INSTALLATION
Heating capacity	300,000 lb per hr	500,000 lb per hr
Storage capacity	2 minutes	10 minutes
Oxygen in deaerated water	.03 ml per liter	.005 ml per liter

The cost . . . less than 50% of the cost of a new deaerating heater.

Write for advice on *your* boiler feedwater treatment without the slightest obligation and ask for your copy of the new technical article "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater".

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

216 WEST 14th STREET, NEW YORK 11, N. Y.

GRAVER

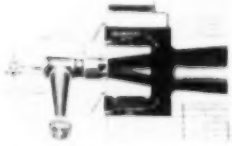
TEN THOUSAND HOURS

WITHOUT SHUTDOWN
IS

NOT "OVERTIME"

. . . for process oil heaters fired by the NATIONAL AIROIL TANDEM COMBUSTION SYSTEM being dirty, wet refinery gas; uncut asphalt; refinery fuel oils . . . HOURS ARE LONG . . . PROFITS ARE HIGH . . . YOU will realize high profits from YOUR heaters when TANDEM COMBUSTION UNITS are specified.

Detailed information sent upon request on your business letterhead.



TANDEM COMBUSTION UNIT

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes. STEAM ATOMIZING OIL BURNERS. MOTOR-DRIVEN ROTARY OIL BURNERS. MECHANICAL PRESSURE ATOMIZING OIL BURNERS. LOW NOx PRESSURE OIL BURNERS. GAS BURNERS. COMBINATION GAS and OIL BURNERS. AUTOMATIC OIL BURNERS for small process heaters and heating plants. FUEL OIL HEATERS. FUEL OIL PUMPING and HEATING UNITS. FURNACE RELIEF DOORS. AIR INTAKE DOORS. OBSERVATION PORTS. SPECIAL REFRACTORY SHAPES.

CHEMICAL PETROLEUM DIV.

NATIONAL AIROIL BURNER COMPANY, INC.

1207 E. SEDGLEY AVE. PHILADELPHIA 34, PA.

chemicals on gel formation and evaluation methods for testing metallic stearates. American Cyanamid Co., Industrial Chemicals Division, 30 Rockefeller Plaza, New York 20, N. Y.

Circle No. 51 on Reply Card

Laboratory Apparatus

What's New for the Laboratory, No. 14, 16-page booklet describing and illustrating new laboratory equipment, including such items as a self-pumping still, teflon-coated ground glass joints, angle head centrifuge, oxyphen—a new pH paper, and chromatopile, developed for the detection, isolation and purification of compounds by chromatographic absorption. Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Circle No. 52 on Reply Card

Solderless Terminal Connections

AMP Technical Data Catalog, 77 pages of information on research and engineering facilities leading to the development of solderless terminals for attaching to solid wire, insulation-piercing types, and special terminals; various types of stock or custom terminals and utilization of these terminals for a wide range of electrical equipment. Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa.

Circle No. 53 on Reply Card

Literature Offered in this Issue's Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature offered in this issue:

ACTIVATED ALUMINA. Booklet offered by Aluminum Ore Co. of America. See ad(s) p. 52.

ADDITIVES, gasoline, specifications, picture and manual offered by Texas Co. Refineries Co. See ad(s) p. 4.

ADDITIVES, for gasoline, lubricating oils, cutting fluids, and emulsions, offered by Monsanto Chemical Co. See ad(s) p. 14.

ALUMINA, fused, for petroleum industries. Bulletin No. 150 offered by the Norton Co. See ad(s) p. 30.

BURNERS, tandem type, information offered by the National Airoil Burner Co. See ad(s) p. 116.

CENTRIFUGE, Technical Data Bulletin No. 7A, offered by Bowen Engineering Co. See ad(s) p. 23.

CONTROL SYSTEMS, electronic, literature offered by The Swartwout Co. See ad(s) p. 24.

COOLING TOWERS, Bulletin offered by the Marley Engineering Corp. See ad(s) inside front cover.

CRACKING CATALYST, Fact Sheet describing Cracking Tower Studies, Cracking Tower Catalyst Inventory Control, Tower Instrumentation, offered by The Filtrol Corp. See ad(s) p. 20-21.

CRACKING TOWERS, Illustrated Bulletin offered by T. P. Pritchard & Co. See ad(s) p. 31.

DRUM CONDITIONING, Booklet #7025 offered by Visco Products Co. See ad(s) p. 111.

DYE, Data Sheet, Information offered by Diamond Alkali Co. See ad(s) p. 2.

EJECTION & EVACUATION, steam jets, offered by Foster Engineering Co. See ad(s) p. 7.

ELECTRIC INSTRUMENTS, automatic process type, literature on offered by Foxboro Co. See ad(s) p. 2.

FILTRATION & TRANSFER, Brochure No. 400 on Refinery Use offered by Kelly Engineering Co., Inc. See ad(s) p. 9.

GAS COMPRESSOR, centrifugal, Catalog section offered by Carrier Corp. See ad(s) p. 26.

GAUGES, pressure, Bulletin offered by Ashcroft Gauge Co. See ad(s) p. 32.

HEAT EXCHANGER EQUIPMENT, Bulletin No. 1 offered by Foster Engineering Co. See ad(s) p. 118.

HEAT TRANSFER EQUIPMENT, Data offered by Young Radiator Co. See ad(s) p. 29.

INSTRUMENTS, for research, Bulletin No. 1141, "Instruments Accurate Research," offered by Minneapolis-Honeywell Regulator Co. See ad(s) p. 11-13.

INSTRUMENTS, for research, Brochure, "Instruments at Work," offered by Minneapolis-Honeywell Regulator Co. See ad(s) p. 14-15.

MANOMETER, Bulletin, Catalog 5e15 offered by Taylor Instrument Companies. See ad(s) p. 3.

MIST ELIMINATORS, Data brochure offered by Mines Testing Corp. See ad(s) p. 109.

PROCESS STREAM ANALYZER, infrared type, Bulletin on offered by Baird Associates, Inc. See ad(s) p. 113.

PUMPS, motor-centrifugal, Bulletin 101 offered by Fluid Pumps, Inc. See ad(s) p. 17.

SEALS, mechanical, Bulletin No. 5402P offered by Durametallic Corp. See ad(s) p. 33.

SEPARATORS, automatic, Bulletin offered by John H. York Co., Inc. See ad(s) p. 108.

STEAM TRAPS, thermostatic, Bulletin 240 offered by W. H. Nicholson & Co. See ad(s) p. 27.

TANKS, STORAGE, 32 page booklet, "Tanks That Stand," offered by Pittsburgh-Des Moines Steel Co. See ad(s) p. 36-37.

TRANSMITTERS, pneumatic, Illustrated bulletin offered by Instruments, Inc. See ad(s) p. 110.

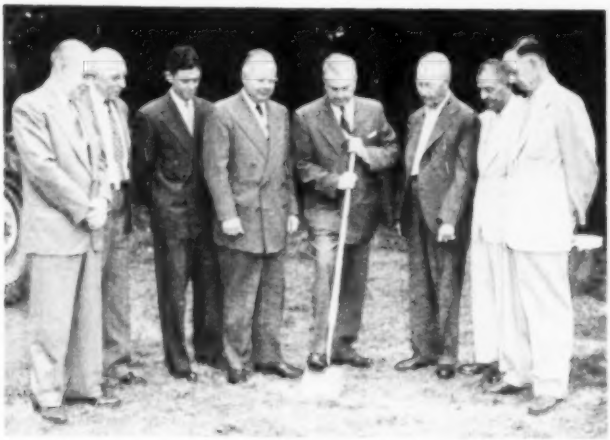
VALVES, for instruments, Information offered by The American Brass Co. See ad(s) p. 19.

TUBE CLEANERS and accessories, Literature offered by Admiral Manufacturing Co. See ad(s) p. 32.

TURBINES, general purpose steam, Type E, Turbine Data Bulletin offered by Westinghouse Electric Corp. See ad(s) p. 25.

WATER TREATMENT, Booklet 5-61 entitled "Trends in Application of Treating Boiler Water & Process Water," offered by Dearborn Chemical Co. See ad(s) p. 115.

WIRES, thermocouple and extension, Catalog section 50A offered by Thermo-Electric Co., Inc. See ad(s) p. 110.



Texaco To Erect New Building

Coincident with the twentieth anniversary of the Beacon Laboratories of The Texas Co., **William B. Logan**, Texaco's manager of refinery operations, turned the first shovel of earth for a new administration building. Joining Mr. Logan in the ceremony signalizing the event were (l. to r.): **Carl E. Cummings**, superintendent of the laboratories; **Joseph F. Connor**, the oldest Texaco employe at the laboratories and now assistant to the superintendent; **R. K. Dietsam**, assistant superintendent; **Dr. Wayne E. Kuhn**, manager of the company's technical and research division; **Mr. Logan**; **Leonard J. Supple**, chairman of the Dutchess County (N. Y.) board of supervisors; **Mayor J. Lewis Bolton** of Beacon, N. Y.; and **Mayor G. William Luther, Jr.**, of Fishkill, N. Y. The two mayors represented the neighboring communities. The new building will provide 23,000 sq. ft. of new floor space and will release about 13,000 sq. ft. of floors space badly needed for research projects directly related to national defense. Mr. Logan, who helped activate the laboratories in 1931, indicated that the new three-story structure would probably be completed early in 1953.

Dr. William E. Hanford, director of petroleum and chemical research for M. W. Kellogg Co., New York, is chairman of the American Chemical Society's Division of Polymer Chemistry for 1952. A native of Pennsylvania, he graduated from Philadelphia College of Pharmacy in 1932, and received his Ph.D. in physical chemistry in 1935 from the University of Illinois.

Dr. Hanford

In 1930 Dr. Hanford was an analytical chemist for the Rohm & Haas Co., Philadelphia, and from 1932-35 an assistant in chemistry at Illinois. He became a research chemist for du Pont at Wilmington, Del., in 1935 and a group leader in 1936. In 1942 he became assistant director of research for General Aniline & Film Corp. and was made director in 1945. He joined the Kellogg company in 1946 as technical consultant and became director of petroleum and chemical research in 1948. During World War II Dr. Hanford was with the Office of Scientific Research and Development.

* * *

Dr. William Arthur Gruse, administrative fellow of the petroleum refining fellowship at Mellon Institute, was the recipient of the Pittsburgh Award for outstanding service in the chemistry of refining petroleum, presented December 20 by the Pittsburgh Section, American Chemical Society. The work of his fellowship, sustained by the Gulf Research & Development Co., has resulted in basic improvement in essentially all petroleum products.

Dr. Gruse

A native of Wheeling, W. Va., Dr. Gruse received his A. B. at Johns Hopkins University and his Ph. D. from the University of Wisconsin. He was the first secretary of the ACS Petroleum Division in 1921, and was chairman of the Pittsburgh section in 1943 and 1944.

* * *

Professor Vladimir N. Ipatieff, director of chemical research for Universal Oil Products Co. and director of the Ipatieff High Pressure and Catalytic Laboratory, department of chemistry, Northwestern University, is to be awarded two high honors of France in recognition of his World War II contributions in aviation gasoline. He has been named a Chevalier of the Cross of Lorraine and Companion of the Resistance, the top distinction of the Knighthood. He is the twelfth American to receive the cross. Professor Ipatieff is also to be awarded the Order of French Association of the Knights of Cyprus and Jerusalem, giving him the highest degree after that of the Grandmaster himself, namely Grand Officer.

Prof. Ipatieff

* * *

Dr. Charles L. Thomas has joined the Research and Development Staff of Sun Oil Co., Philadelphia. The past six years he has been Director of Research and Development for Great Lakes Carbon Corp.

Dr. Thomas

Dr. Thomas is well known for his publications and patents. In the American Chemical Society, he has been Vice Chairman of the Petroleum Division and Chairman of the Chicago Section. A native of North Carolina, he received both B.S. and M.S. degrees from the University of North Carolina and his Ph. D. from Northwestern University.

* * *

Dr. Daniel P. Barnard, IV, research coordinator of Standard Oil Co. (Ind.), Chicago, Ill., was elected today to the presidency of the Society of Automotive Engineers for 1952. He succeeds **Mr. Dale Roeder** of the Ford Motor Co.

Dr. Barnard has dedicated years to the matching of fuels and engines, winning the SAE Horning Memorial Award in 1949, for distinguished active service in this field. He graduated in 1919 from the University of

Dirty Water can't "Shut-down"...

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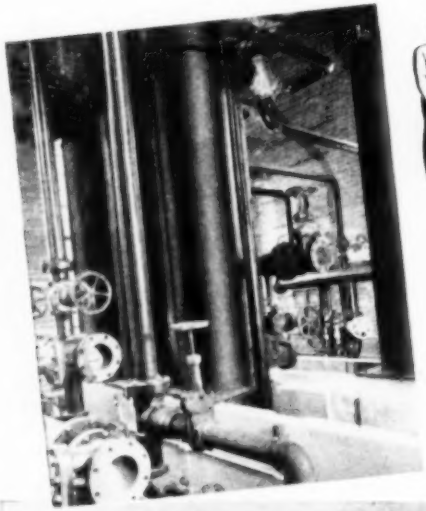
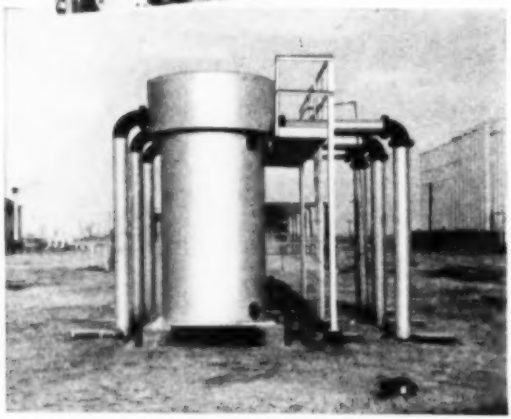


film type exchangers

(Condensers–Coolers–Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,500 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

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Delaware with a B. S. degree in chemical engineering. He received his master's and Ph. D. degrees from M.I.T., continuing there for one year as laboratory director.

In 1925, Dr. Barnard became affiliated with Indiana Standard. He established the company's automotive engineering laboratory at the Whiting refinery. He has been a director of the Coordinating Research Council since its incorporation, and served as president in 1948-49-50.

* * *

Dr. Edmond L. d'Ouville has been appointed division director of research in the Standard Oil Co. (Indiana) research department at Whiting, Ind. He is to continue also as senior technologist in the development and patent department in the company's general office at Chicago.

Dr. d'Ouville

He joined Indiana Standard in 1937 as a research chemist at the Whiting laboratories. In 1942 Dr. d'Ouville left the company to join the staff of the Mellon Institute in Pittsburgh as a research fellow. He returned to Indiana Standard in 1944 as senior technologist in the development and patent department.

* * *

Dr. Raymond E. Schaad has been appointed technical adviser to Col. J. C. Raaen, manager of Universal's Research and Development Laboratories at Riverside, Ill.

Dr. Schaad recently completed twenty-five years with Universal.

He is a graduate of Denison University and received his Ph. D. degree in chemistry from Ohio State University.

* * *

Harold Shalit has joined the research division of Houdry Process Corp. He was formerly associated with the research department of Standard Oil Co. (Indiana). He received his Ph. D. from Polytechnic Institute of Brooklyn.

Another new member of Houdry's research staff is **L. Edward Godycki**, who recently received his Ph. D. from Iowa State.

* * *

Walter H. Johnson, chemical engineer formerly with the Pure Oil Co., has joined the research staff of Standard Oil Co. (Indiana) at Whiting, Ind. Mr. Johnson is a graduate of Northwestern University.

* * *

H. R. Wall, assistant superintendent of Continental Oil Co.'s Ponca City, Okla., refinery, has been promoted to superintendent. He succeeds **C. D. Hull**, who has been promoted to the newly created position of manager of the Ponca City refinery.

L. D. Grubb, director of technical services for Cit-Con Oil Corp., Lake Charles, La., has been named assistant superintendent at Ponca City, succeeding Mr. Wall.

Receiving his B. S. degree in electrical engineering from the University of Colorado, Mr. Wall joined Continental at the Denver refinery in 1935. He became superintendent of the Lake Charles refinery in 1948 and assistant superintendent of the Ponca City refinery in 1950.

Mr. Grubb, a graduate of Kansas State College, joined Continental as a technologist at Ponca City in 1939. He was transferred to the Cit-Con refinery at Lake Charles in 1947 as director of technical services.

* * *

Dr. Arthur B. Hersberger, manager of Chemical Products Section of the Domestic Sales Department of the Atlantic Refining Co., Philadelphia, has been appointed manager of the Product Sales Division. He is succeeded in his former position by **John Martin Hoerner**.

Dr. Hersberger

Dr. Hersberger joined Atlantic in 1936 as an associate chemist. In 1940, he became a group leader in the research and development department, and in 1944 was made a divisional director. He was appointed manager of the newly-created Chemical Products Section in 1947.

* * *

Harold E. Reppen has been promoted to group leader in technical service at the Whiting, Ind., research laboratories of Standard Oil Co. (Ind.). Mr. Reppen joined the company in 1943 as a chemical engineer following graduation from the University of Illinois.

* * *

Three Shell Development Co. research chemists from the Emeryville, Cal. plant have taken up temporary assignments to obtain broader experience with refinery operating problems.

J. H. Raley has been assigned to the Houston refinery for a two-year period.

J. W. Otvos has been assigned to the Wood River, Ill., refinery for two years.

G. E. A. Wyld was assigned to Wood River for a year in an exchange with **K. Kressler** of the control laboratory, who is to join Shell's analytical staff.

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EDITORIAL VIEWPOINTS

Opinions and Comments on Current Topics

What Is a Petrochemical?

THE term petrochemical has come into such wide use in the refining industry in the past few years that it must be considered as including the wide range of new products being derived from petroleum and natural gas. Actually, the word is a misnomer, since "petro" comes from the Greek and means stone. As yet there is no standard definition of a petrochemical in the dictionaries or glossaries of technical terms. Even the industry itself has different ideas of the definition of the word.

The mild controversy which has been taking place on this point was largely of only academic interest until the Office of Price Stabilization, in acting up prices for petrochemicals, also announced its definition of the term. Here is the definition as given in the OPS release of Nov. 29, CPR 22, Amendment 1 to Supplementary Regulation 12: "Synthetic organic chemicals containing one or more carbon atoms using fractions of crude petroleum, including hydrocarbon components of natural gas, for raw materials."

Some oil company technologists are in general agreement with the OPS definition. Others, however, think it is too restrictive, since it apparently limits a petrochemical to products derived by synthesis from crude oil fractions or natural gas, and thus rules out products secured by extraction or extractive distillation, such as benzene and toluene, although these are also derived by synthesis. Ethylene, source material for a large number of chemical products, is being made commercially by cracking propane-ethane mixtures, as well as by synthesis. Under the OPS definition would ethylene made by synthesis be a petrochemical, but not ethylene by cracking?

There are subcommittees of both the API Refining Division's Committee on Petroleum Products and of ASTM's Committee D-2 whose responsibilities include the formulation of meanings for words and terms specific to petroleum refining. It is hoped that their work in the near future will lead to a definition for "petrochemical" which can have official status and industry-wide acceptance, thus avoiding the possibility of some arbitrary and limiting definition coming into general use.

—V.B.G.

New Concept in Synthetic Fuels

WRITING in this issue of PETROLEUM PROCESSING (p. 41) Eugene Ayres, a member of the National Petroleum Council's subcommittee on synthetic fuel costs, supports the generally accepted view that our large volume of such products to supplement petroleum will come from coal.

He injects a new thought into the discussion by pointing out that a sound development of the production of liquid fuels from coal will come through recognizing a supply-demand relationship as existing between these two sources of energy, synthetic fuels and coal as a direct fuel. Mr. Ayres sees a greatly increased demand in future years for coal for producing electric power, among other uses. A system, or processes, for making liquid fuels from coal that will be successful commercially, he believes, must essentially be flexible so as to provide a means for balancing supply and demand for the two fuels.

Mr. Ayres' remarks might be particularly pertinent for the start and early stages of a commercial synthetic liquid fuel industry using as its raw materials the high grade bituminous coals located in areas capable of extensive industrial development. To compete with petroleum in this period without government subsidies, synthetic fuels must come from low cost raw materials or, if the material cost is high, be secured along with other products from the same material and carrying part of the cost.

Some technical work is already well advanced, based on a dual role for coal, both as a direct source of energy and also as raw material for creating liquid fuels. Pittsburgh Consolidation Coal Co.'s low temperature carbonization process produces gas, tar liquid and a fine char which is the equivalent of powdered coal and said to be as suitable for industrial use.

If developments along this line, as many believe, do provide the logical approach to the establishment of a commercial synthetic fuel industry, it would appear to make even more impractical the Bureau of Mines coal hydrogenation project and similar processes which call for complete conversion of the coal prepared and submitted to processing. —V.B.G.

Meeting Sponsors Please Note

EARLIER this month we attended the 44th Annual Meeting of the American Institute of Chemical Engineers in Atlantic City. The meeting lasted four days; 46 technical papers were presented; and many of the 1500 persons who attended were from the petroleum industry.

One thing that struck us in particular about the entire meeting was the attention paid to the program by everyone there. The technical sessions were exceptionally well attended—to the extent that even standing room was at a premium in many cases. Persons standing around the lobbies, foyers and registration areas during the sessions were few and far between.

It was quite a contrast (and a welcome one) to some of the other technical gatherings we've been at where social activities seem to dominate the scene and excellent technical programs get far too little attention.

The AIChE (and the Wilmington-Philadelphia section, host for this meeting) gets a well-deserved round of applause from us for its policies in holding carefully-planned meetings which are not so large as to be unwieldly.

—W.F.B.

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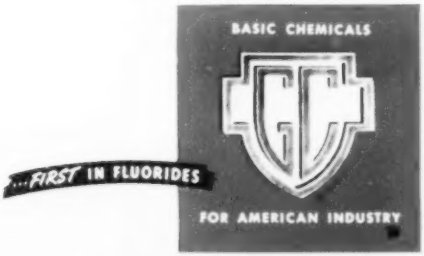

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Potassium Polyacid Fluoride 50
Sodium Bifluoride

ALKALI FLUOBORATES
Ammonium Fluoborate
Potassium Fluoborate
Sodium Fluoborate

ALKALI FLUORIDES
Ammonium Fluoride
Potassium Fluoride
Sodium Fluoride

DOUBLE FLUORIDES
Potassium Aluminum Fluoride
Potassium Chromium Fluoride
Potassium Ferric Fluoride
Potassium Titanium Fluoride
Potassium Zirconium Fluoride

METAL FLUORIDES
Aluminum Fluoride, Crystal
Antimony Trifluoride
Antimony Pentafluoride
Barium Fluoride
Cadmium Fluoride
Calcium Fluoride
Chromium Fluoride
Cobalt Trifluoride
Copper Fluoride
Ferric Fluoride
Lead Fluoride
Magnesium Fluoride
Molybdenum Hexafluoride
Nickel Fluoride
Strontium Fluoride
Titanium Tetrafluoride
Tungsten Hexafluoride
Zinc Fluoride
Zirconium Tetrafluoride

METAL FLUOBORATE SOLUTIONS
Cadmium Fluoborate
Chromium Fluoborate
Cobalt Fluoborate
Copper Fluoborate
Ferrous Fluoborate
Indium Fluoborate
Lead Fluoborate
Nickel Fluoborate
Silver Fluoborate
Stannous (Tin) Fluoborate

NON-METAL FLUORIDES
Boron Fluoride Gas
Boron Fluoride–Diethyl Ether Complex
Boron Fluoride–Phenol Complex
Boron Fluoride–Other Complexes
Sulfur Hexafluoride

HALOGEN FLUORIDES
Bromine Trifluoride
Chlorine Trifluoride
Iodine Pentafluoride

ORGANIC FLUORINE COMPOUNDS
Genetron 100—$CH_2 \cdot CHF_2$
Genetron 101—$CH_2 \cdot CCl_2F$
Genetron 131—$CCl_2 \cdot CClF_2$
Genetron 150—$CH_2 \cdot CF_3$
Genetron 160—$CHCl_2 \cdot CF_3$
Genetron 170—$CCl_2 \cdot CF_3$
Genetron 265—$CClF_2 \cdot CF_3$

The products listed include those which are commercially available or will be in full production soon. Others are available only in experimental quantities. For further information on any of them, or on other fluorine compounds you may require, consult the General Chemical Product Development Department.

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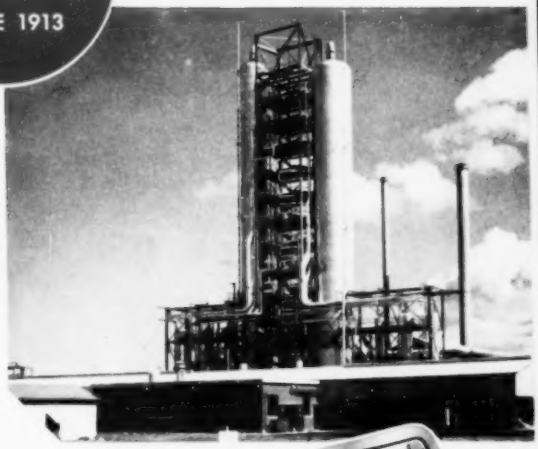

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